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WITH WHICH IS CONSOLIDATED WESTERN ELECTRICIAN AND ELECTROCRAFT

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Fig. 1.—View of Compressor Room, Showing Three 500-Hp. and Two 300-Hp. Synchronous Motors Driving Compressors, and Their Control Panels.

Large Installation of Synchronous Motors in Cold-Storage Plants

Layout of a Chicago Warehouse — Deciding Upon Power Supply—Synchronous Motors Used—Features of Installation

In the Central Manufacturing District, Chicago, is located a cold-storage warehouse possessing a huge storage capacity for refrigerated products and a large ice-making capacity. This plant is electrically operated throughout and employs synchronous motors for all except the small drives.

This cold-storage warehouse, located at Hoyne avenue and Thirty-ninth street, Chicago, a locality teeming with storage warehouses, packing plants and manufacturing establishments, was erected for the Government during the war, the intention being to store meats and other perishable products as necessary in their journey from the stockyards and neighboring production centers to the army in various camps and oversea. The structure is one of the largest and most attractive of its kind in the country. The original proposal for cold-storage warehouse was made in July, 1918, and work started on the 25th of the same month. On Jan. 20, 1919, occupancy of the basement took place and by March 15, 1919, the entire building was occupied for freezing purposes. This warehouse is probably the most quickly constructed building of its size ever built and stands a magnificent monument to organization and construction on the part of Government officials and American engineering talent.

The cost of the project was $2,150,000, exclusive of the land. The total cost of the refrigerating equipment was $900,000, making the total cost, excluding real estate, to more than $3,000,000. The storage capacity approximates 58,250,000 lbs. Of this amount 26,250,000 lbs. is in the freezers, 8,000,000 lbs. in the sharp freez-

ers and 24,000,000 lbs. in ordinary storage. The building is of reinforced concrete faced with red brick and trimmed with terra cotta, comprising six stories and basement, with a two-story wing addition in the rear for containing the refrigerating machinery and ice plant, which has a 5000-ton storage capacity.

The main structure measures 223 ft. wide by 323 ft. in depth. The two-story addition and basement measure 143 by 145 ft. Including the additions, the total area of the buildings is about 586,000 sq. ft. and the volume 8,600,000 cu. ft. As mentioned before, the total storage is approximately 58,250,000 lbs. Each of the floors is divided into four sections, a storage freezer being located at either end with two sharp freezer sections in the center. Train sheds and unloading platforms permit of 50 railroad cars being loaded simultaneously. The railroad tracks are on two sides of the building. On the one side cars are unloaded into storage and on the other side loaded from storage. There is also ample loading platform for trucks and similar vehicles for material and ice loading platform from which ice may be loaded for city distribution.

On each side are four electric freight elevators of the worm-and-gear drum type, each elevator having a car platform area of about 125 sq. ft. (13 by 9.5 ft.) and a lifting capacity of 6000 lbs. Each platform has 32 ft. of track, from which can be hung 4000 lbs. of beef in quarters. If making 16 trips per day, each elevator is therefore able to handle 16 tons of meat per hour. All six floors are served by a complete interconnecting trolley track layout for facilitating the handling of meat.

Cooling is effected by the direct-expansion ammonia system, which is made up of 800,000 ft. of 2-in. pipe. The refrigerating plant, located in the rear of the two-story building, was intended originally to contain four high-pressure refrigerating machines, but on account of the eventual return to normal conditions on cessation of hostilities, it was decided as best to install only three machines. At the present time, therefore, the plant contains three compressors and two boosters with an aggregate capacity of 1005 tons of refrigeration.

The three compressors are horizontal, twin-cylinder, double-acting machines, with cylinders measuring 17 by 36 ins. Each unit has a 15-ton flywheel, measuring 18 ft. in diameter with a 43-in. face. The two boosters, located between the main compressors and in a row with them, are of the twin type, with 30 by 42-in. cylinders and 12-ton flywheel measuring 18 ft. in diameter with a 32-in. face. These boosters have a displacement of approximately 34 cu. ft. apiece. The compressors have a speed of 70 r.p.m. and the boosters 60 r.p.m. For the compressor drive a three-ply, 42-in. leather belt on 35-ft. centers is used; the belt for the compressors is 30 ins. wide on 36-ft. centers. The ammonia vapor comes from the storage house to the boosters at a pressure very close to atmospheric. It is then delivered to the high-pressure machines at about 20 lbs. per sq. in. and discharged to the condenser at a pressure usually varying between 150 and 175 lbs. All five units are motor driven, the motors receiving their energy at 2200 volts from supply lines direct from the power plant of the Produce Terminals Corp.

Considerations Deciding Source of Power.

The cold-storage warehouse was planned and constructed during the war with the express purpose of offering a means for the Government

Fig. 2.—The Two 75-Kw. Exciter Sets, Driven by Synchronous Motors.

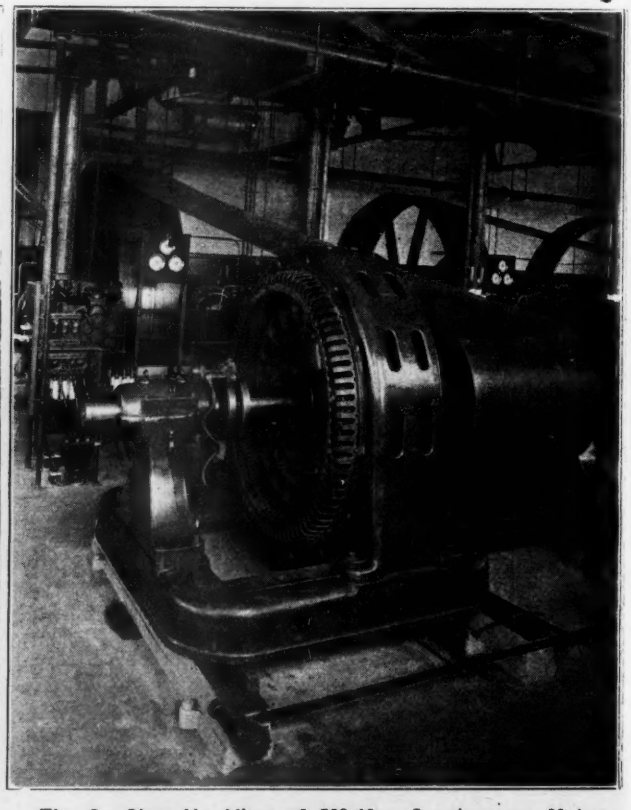


Fig. 3.—Close-Up View of 500-Kw. Synchronous Motor from Excitation Side.

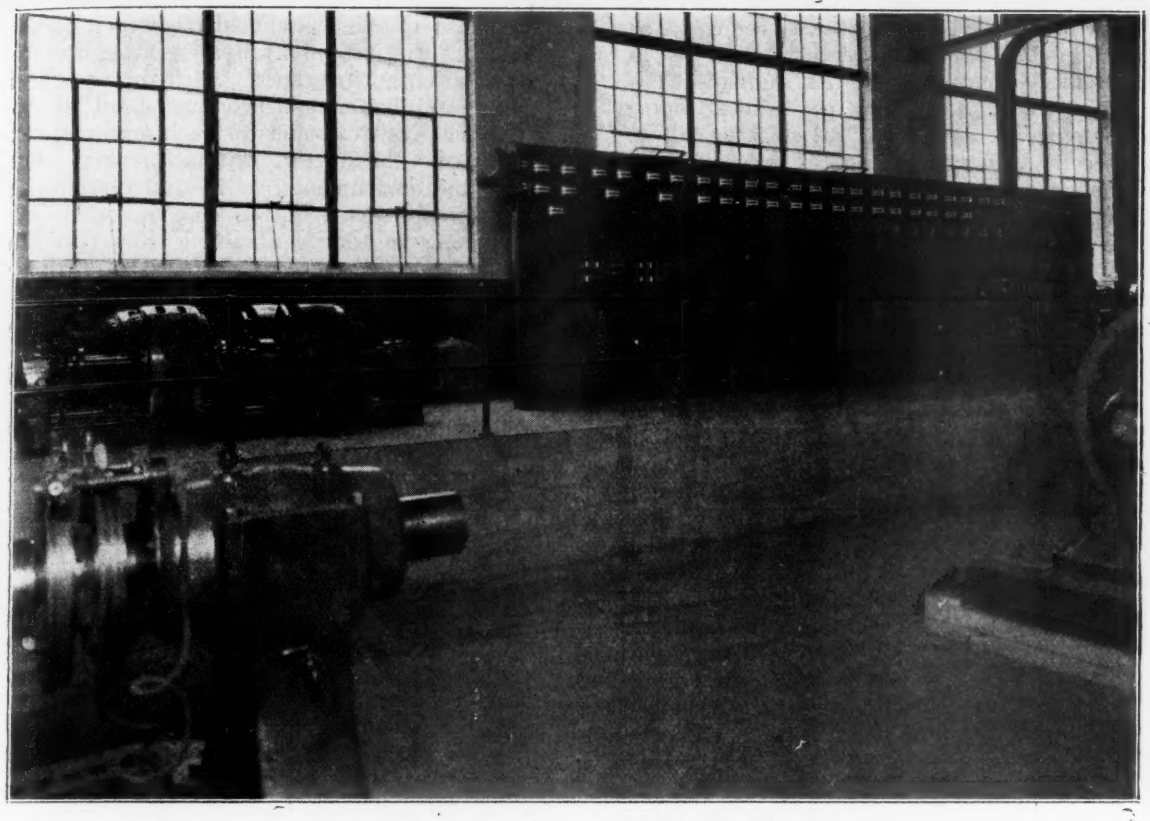


Fig. 4.—View of Switchboard and Two Exciter Sets.

to ship rapidly and store flexibly the vast amount of perishable foods required by the troops. Immediate results were vital and at the same time it was remembered that some time the war would be won, and if expenditures made for winning the war could be turned to equal usefulness when peace came, so much the better.

In deciding upon the relative advantages and feasibility of steam and electricity a number of factors overwhelmingly favored the latter. During the war it was extremely difficult and sometimes impossible to obtain the delivery of steam-generating and steam-using equipment. Moreover, the fuel situation was a difficult one and fuel conservation was of paramount importance. Time was thus a factor and reliability of operation another factor. The steam power plant of the Produce Terminals Corp., which furnishes a large amount of power for the stock yards and central manufacturing districts, was within convenient distance of the cold-storage warehouse. This plant had recently made considerable extensions to its generating station and was also purchasing a large amount of power from the Commonwealth Edison Co. at 12,000 volts. The proximity of this source of cheap electrical energy, in conjunction with the relative operating economies and reliability of purchased electric service, resulted in a decision to purchase power and thus employ electric drive.

The power required for each of the three high-pressure compressors was 500 hp. and for the two boosters, 300 hp., on the basis of 30-deg. temperature rise.

Why Choice of Motors Went to Synchronous Type.

At the time the installation was planned the restrictions and emergencies of war were forcing attention upon operating efficiency and any factor that went toward conserving fuel and reducing the demand upon apparatus of any kind was deserving of the most deliberate consideration. It was for these reasons, efficiency and power-factor, that the final choice in favor of synchronous motors was made.

The accompanying vector diagram gives a graphic comparison of induction and synchronous motor drive; and it was a very similar diagram that actually convinced the Government as to the superiority of the synchronous motor. With the synchronous motors operating on a basis of power-factor, the kilovolt-ampere demand on the generating station, underground lines and substation apparatus will equal the kilowatt demand. The 500-hp. induction motors that would be used if synchronous motors were not employed were presumed to have an efficiency of 92.5% and a power-factor of 81% at full load. The line *OA*, drawn through the point corresponding to 81 (the induction-motor power-factor) on the arc representing power-factor, and to a length equivalent to that corresponding to a kilovolt-ampere input for four motors gives approximately 1980 kv-a. Adding the load due to the two 300-hp. induction motors driving the boosters, with their efficiency of 91% and 77% power-factor, gives a total demand of 2630 kv-a. as indicated by line *OC*, and a power-factor of 80%. When employing induction motors, the kilovolt-ampere demand on the station will be represented by the line *OC* in Fig. 5, which is equal to the line *JK*, or 2620 kv-a. The kilovolt-ampere demand when using synchronous motors is given by the line *LM*, which scales to 2086 kv-a.

Taking into consideration the power-factor in both instances, the kilowatt demand is 2096 for

the induction motors and 2086 kw. for the synchronous motors, being a difference of 10 kw. in favor of the synchronous motors. On the basis of an energy charge of 1 cent per kilowatt-hour, this difference is equivalent to a saving of 10 cents per hour in cost of energy by using the synchronous motors. But this is not all. The line *OD* shows that there is a demand of 1565 wattless kilovolt-amperes with induction motors, whereas with the synchronous motors operating at 100% power-factor the wattless demand upon the supply system is zero. With a demand upon the generating system of 2620 kv-a., when using induction motors, and 2086 kv-a. when using

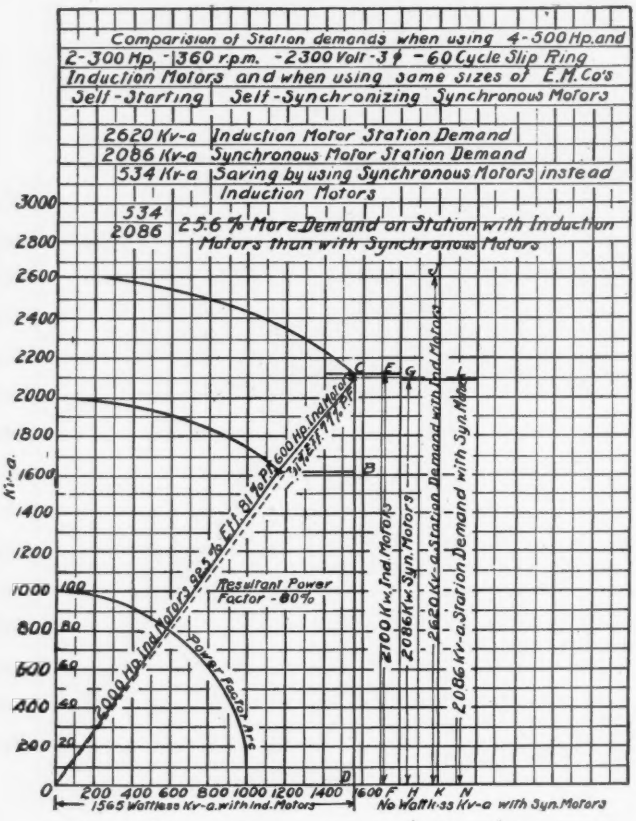

Comparision of Station demands when using 4-500 Hp. and
2-300 Hp. - 360 r.p.m. - 2300 Volt - 3 ϕ - 60 Cycle Slip Ring
Induction Motors and when using same sizes of E.M.Co's
Self-Starting Self-Synchronizing Synchronous Motors
2620 Kv-a Induction Motor Station Demand
2086 Kv-a Synchronous Motor Station Demand
534 Kv-a Saving by using Synchronous Motors instead Induction Motors
534
2086
25.6% More Demand on Station with Induction Motors than with Synchronous Motors
Kv-a
Resultant Power Factor - 80%
2100 Kw. Ind. Motors
2086 Kw. Syn. Motors
2620 Kv-a. Station Demand with Ind. Motors
2086 Kv-a. Station Demand with Syn. Motors
1565 Wattless Kv-a. with Ind. Motors
No Wattless Kv-a with Syn. Motors

Fig. 5.—Vector Diagram for Visualizing Relative Performance of Synchronous Motor and Induction Motor.

synchronous motors, it is seen that there is a saving of 534 kv-a. in connected demand made possible by employing the latter type of motor. Expressed differently, this means that if induction motors had been used instead of synchronous motors, the supply system would have to be capable of meeting a demand 25.6% greater than with the synchronous motors of the same capacity as the induction motors. The cost of synchronous motors is somewhat higher than that of induction motors but this is an item that is soon turned to profit by lower demand rate, based upon connected load in kilovolt-amperes and a lower energy consumption.

The synchronous motors were guaranteed to be capable of carrying a continuous overload of 25% with a 50-deg. temperature rise, equivalent to a motor output of 650 and 375-hp., respectively, for the 500 and 300-hp. synchronous motors, and were furnished by the Electric Machinery Co.

Electrical Supply and Control.

Energy is delivered at 2200 volts, 60 cycles, three-phase to the switchboard where it is distributed to the individual motors through motor control oil circuit-breakers. Each motor is self-starting and has a synchronous speed of 360 r.p.m. The control panel for each machine, consisting of autostarter, circuit-breaker, field switch and instruments, is located directly beside it, as shown in Fig. 1. Excitation for the synchronous motors is obtained from two synchronous-motor-driven generator sets installed upon the switchboard or operating gallery (Fig. 4). The synchronous motor of these sets is rated at 75 and the 220-volt, direct-current generator at 50 kw. Either exciter set is capable of furnishing excitation for all the five synchronous motors as well as for its own synchronous motor.

In addition to the three 500-hp. motors for driving the three main compressors, the two 300-hp. motors for driving the booster compressors and the exciter sets, there are a number of 220-volt induction motors employed for driving auxiliary apparatus; for example, the three 30-hp. induction motors are used for driving three 1000-g.p.m., single-stage, centrifugal pumps for circulating the condenser water; one 16-hp. induction motor for driving a 15-ton pump for pumping the ammonia from the circulating system, the motors for the freight elevators and passenger elevator, and a number of smaller motors for the ice cranes, etc. All these motors operate at 220 volts and are of the squirrel-cage type.

The cold-storage warehouse, the outstanding electrical features of which have been touched upon above, has been in operation almost a year. During this time the synchronous motors—in fact, the entire electrical equipment and layout—have proved reliable and admirably chosen and apportioned to their task.

The plans for the project were prepared by S. Scott Joy, architect, who retained Henschien & MacLaren as consulting engineers, for the Central Manufacturing District, the contractors. The Government was represented by Major S. L. Nelson, constructing quartermaster; S. F. Forbes, supervising engineer, and Gardner & Lindberg, supervising architects. F. J. Roose is chief engineer in charge of operation. At the present time the warehouse is understood to be under lease from the Government.

EXPORTS TO GERMANY INCREASE.

Merchandise exported to Germany from the United States last year totaled close to $100,000,000, according to the Bureau of Foreign and Domestic Commerce figures. Though technically still at war with Germany and Austria, American trade with those countries is increasing. Practically half of the 1919 exports to Germany were shipped in November and December. Merchandise shipped to Austria in 1919 amounted to $42,211,000.

HUMPHREYS IS INSTITUTE HEAD.

Alexander C. Humphreys has been elected president, S. Whinery, vice-president, and F. A. Molitor, secretary and treasurer of the American Institute of Consulting Engineers, Inc. The offices of the Institute are in New York City.

Comparison of Steam Power-Plant Performance

Comparisons Based Upon B.t.u.—Comparison of Coals and Coal Costs—Comparison of B.t.u. per Kilowatt-Hour—A.I.E.E. Paper

By W. S. GORSUCH

Engineer, Economics, Interborough Rapid Transit Co., New York City.

The principal difficulty with operating statistics of steam power plants as published today by various state and governmental bodies is that they are wholly inadequate for the purpose of determining the efficiency of a plant or making general comparisons between different plants. In practically every case the bare figure of coal consumption per kilowatt-hour is given without any reference whatever to the quality of coal and without a clear understanding as to the character of the load on the station. When load-factors are given, the figures are often misleading because they are computed upon different bases. No uniformity exists in reporting the output of the power plant, the gross output being used in some cases and the net output in others. Because of these facts the reports as at present published are limited in their use, principally serving to show the total amount of power generated and the total quantity of coal consumed.

The object of this paper is to point out the essential items of steam power-plant performance which should be recorded in statistical reports, and to suggest a uniform method of expressing them for the purpose of making a general comparison between different plants, without going into an analysis of the thermal characteristics or cost of generation.

It must be conceded that the proper criterion for comparing power plants is the commercial efficiency, that is, the total cost per kilowatt-hour sent out from the a-c. power station bus, which is the ultimate test of design and operation. To make such a comparison, a uniform system of accounting would have to be adopted and suitable correction factors would have to be established whereby the operating results and conditions can be reduced to a more or less common basis, all of which is beyond the scope of general statistical reports. For this reason, the discussion of costs in this paper will be limited to that of coal, which is the largest single item in the cost of generation.

What is said here refers particularly to steam power plants using coal as fuel and in which all the output is in the form of electrical energy, but the principles relate in their broad application to steam power plants using fuel other than coal and where both steam and electrical energy are supplied.

For the purpose of obtaining a better knowledge of what a plant is doing and for judging the relative merits of different plants, it is recommended that the following items be recorded in statistical reports relating to power generation in steam power plants, and that they be expressed in a uniform way as indicated. These items reflect the influence of station design and arrangement of apparatus, method of operation and management, load, quality and kind of fuel used, and at the same time indicate the character of the load imposed upon the station. For convenience the items are divided into two groups—coal characteristics and load characteristics.

I.—*Coal Characteristics of the Plant.*

(1) Average B.t.u. supplied to plant per kw-hr. net output.
(2) Thermal efficiency of plant in per cent.
(3) Average B.t.u. per dollar, coal as received (moist basis).
(4) Coal factor or pounds of coal per kw-hr. net output (moist basis).
(5) Average B.t.u. per pound of coal as received (moist basis).
(6) Cost of coal per ton (2240 lbs.) delivered alongside of the plant.
(7) Kind and character of coal.
(8) Cost of coal in cents per kw-hr. net output.

II.—*Load Characteristics of the Plant.*

(9) Average daily load-factor of load.
(10) Maximum load for the year.
(11) Yearly load-factor of load.

(9), (10), (11): Interval of maximum load 15 minutes or 1 hour, depending upon character of load.

(12) Kilowatt-hours net output for the year—(kilowatt-hours sent out from the a-c. bus).
(13) Installed rated capacity, that is, the aggregate maximum continuous rating of the generators in kilowatts.
(14) Average kilowatt-hours net output per kilowatt installed rated capacity.

Items 1, 2, 3, 8, 11 and 14 can readily be computed from items 4, 5, 6, 10, 12 and 13.

Coal Characteristics.

The fundamental basis of determining and comparing steam-power plant efficiencies as to coal consumption should be the average B.t.u. supplied per kilowatt-hour net output at the power station bus. This will give a basis for discussing and comparing plant efficiencies upon which there can be no misunderstanding. With this factor and a knowledge of the character of load, we have a very good criterion by which to judge the merits of a plant both as to design and operation. The average B.t.u. supplied to the plant per kilowatt-hour net output for the year is determined by dividing the kilowatt-hour net output for the year into the product of the total pounds of coal used during the year by the average B.t.u. per pound of coal as received (moist basis). This measure of efficiency can be expressed in thermal efficiency or what is generally termed over-all plant efficiency, by dividing it into 3415.

Before a very close comparison can be made between two plants each of which uses a different grade of coal, the coal characteristics of both plants will have to be placed on the basis of coal having the same quality. This involves the effect of quality of coal on the boiler capacity and efficiency which must be taken into account if the object sought is to make an analysis of the thermal characteristics of the plants. However, since the purpose of this paper is to deal with general comparisons which can be made from statistical records without going into a detailed study of the plants, it is proposed to make fairly close comparisons which correct for the difference in the B.t.u. value of the coal itself but which neglect the effect on the boiler capacity and efficiency. Notwithstanding this inaccuracy, which will be relatively small, even with a large difference in the quality of coal, the comparisons as outlined are much more useful than any that can possibly be made from the statistical information published today.

Two plants can be directly compared as outlined above on the basis of the average B.t.u. supplied per kilowatt-hour net output, because both the coal factor and quality of coal are taken into account. A comparison, however, cannot be made between the coal factors as given without first correcting for the difference in the B.t.u. value of the coal used. This can be done by multiplying the coal factor of either plant by the ratio of the B.t.u. value of the coal used by that plant to the B.t.u. value of the coal used by the other plant, thus placing the coal factors on the same basis insofar as the B.t.u. value of the coal itself is concerned.

Because of the lack of laboratory facilities it may not be possible for some small plants to determine the average B.t.u. value of all the coal consumed during the year. In such cases the results of periodic tests should be recorded with an explanatory footnote, as they will serve to give a general idea of the conditions under which that upsets the boiler-room force so much as that upsets the boiler room force so much as changing the grade of coal without notice, since every change necessitates a readjustment of methods of firing. With a knowledge of just what kind of coal is being supplied, the cause of the change in efficiency can more readily be traced.

Generally speaking, the highest thermal efficiency is obtained when burning the highest quality of coal. On the other hand, a low grade of coal purchased at a low price may result in a better commercial efficiency. The B.t.u. per kilowatt-hour net output together with the B.t.u. per dollar will, therefore, give an index of the commercial efficiency of the plant, since coal is by far the largest item in the cost of power production.

Where mixed fuel is used, the relative amount of anthracite and bituminous coal should be recorded, together with the average B.t.u. value of each.

Load Characteristics.

The character of load carried has a marked influence on plant efficiency, a fluctuating load and a load with sharp peaks and low load-factor require more coal than an equally steady load or a load with a high load-factor. In comparing plant performance, therefore, it is essential to know the load conditions. These are best indicated by the ratio of the average load to the maximum load for the same period, which is known as the load-factor of load and is usually expressed in percentage. Industrial and railway loads are less affected by seasons and daily weather conditions than lighting loads. For this reason it is recommended that the interval for the maximum load be 15 minutes from stations supplying an appreciable lighting load and 1 hour for all other stations.

Much confusion is caused throughout the electrical industry, due to the fact that a uniform method has not been used in determining the load-factor. For the purpose of comparing the load conditions of various generating stations, the daily load-factor seems to be most suited, and it should be the ratio of average net output during 24 hours to the net maximum load, multiplied by 100 to express in percentage. The load-factor should be computed on the basis of 24 hours for the reason that it represents the relation between the actual and possible hours' use of the maximum load. In comparing power-station statistics, which are usually on a yearly basis, the average daily load-factor should be used because it is more representative of the operating conditions in the plant itself than a load-factor based on the maximum of the month or year.

The fundamental basis of determining and comparing those items of power-plant performance that are expressed in terms of unit output

	I. *Coal Characteristics of the Plant.*	Plant A.	Plant B.
1.	Average B.t.u. supplied to plant per kw-hr. net output	22,400	25,600
2.	Thermal efficiency of plant in per cent	15.24	13.34
3.	Average B.t.u. per dollar, coal as received (moist basis)	5,226,666	5,734,400
4.	Coal factor, or pounds of coal per kw-hr. net output (moist basis)	1.60	2.00
5.	Average B.t.u. per pound coal, as received (moist basis)	14,000	12,800
6.	Cost of coal per ton (2240 lbs.) delivered alongside plant	6.00	5.00
7.	Kind of coal	Bituminous	Bituminous
8.	Cost of coal in cents per kw-hr. net output	0.428	0.446
	II. *Load Characteristics of the Plant.*		
9.	Average daily load-factor of load*	50	54
10.	Maximum load for the year*	90,000	80,000
11.	Yearly load-factor of load*	40	38
12.	Kw-hrs. net output for the year (kw-hrs. sent out from the a-c. bus)	315,460,000	217,248,000
13.	Installed rated capacity, that is, the aggregate maximum continuous rating of the generators in kws	125,000	100,000
14.	Average kw-hr. net output per kw. installed rated capacity	2,525	2.173

*Interval of maximum load one hour.

of the plant, should be the kilowatt-hour net output. This will eliminate any difference in power consumption of auxiliaries or power used for other purposes in the plant. The result will be that all the factors will be on the basis of the character of load imposed upon the plant.

The plant-factor, which is the ratio of the average hourly load for the year to the rated capacity of the plant, is a measure of the utilization of the installed capacity. This is obtained by dividing 8760 into Item 14.

For the purpose of illustrating the advantage of the proposed over the present method for preparing statistical reports relating to power generation in steam power plants, the preceding comparison is made between a few of the items of two plants, A and B, which have similar load characteristics but which use coal differing in quality and price.

A comparison of Items 1 and 2 shows that on the basis of plant A, plant B has a 12.5% lower plant efficiency and requires 14% more B.t.u. per kilowatt-hour net output at the station bus. If the effect on boiler capacity and efficiency due to quality of coal are neglected, the lower efficiency for plant B can be attributed principally to a difference either in station design or method of operation or both since the load characteristics are practically the same.

The equivalent coal-factor of plant B based on coal having 14,000 B.t.u. per pound is 1.83 lbs. or 0.23 lb. more per kw-hr. net output than that required for plant A. This means that for the same output and with coal having the same B.t.u. value, plant B consumes approximately 14% more coal than plant A.

With the present method of recording power plant statistics, Item 4 showing the coal-factors would be given, but Items 1, 2, 3 and 5 would not. In this case it would be impossible to tell whether or not any part of the difference in the coal-factors was due to the quality of coal. If the relative merits of the two plants were judged from the coal-factors alone, the comparison would be misleading for the reason that while the coal-factor for plant B is 25% higher than that for plant A, the B.t.u. supplied per kw-hr. net output is only 14% higher. This very clearly brings out the fact that a general comparison cannot be made between the coal-factors of two plants without a knowledge of the relative B.t.u. value of the coals used.

Other interesting comparisons can be made from the above tabulations, one of which is the cost of coal per unit of output. The figures given in Item 8 show that the cost of coal per kw-hr. net output for plant B is approximately 4.2% higher than that for plant A.

The above discussion demonstrates the need of a uniform standard method of recording the fundamental factors of steam power station per-fundamental factors of steam power-station performance in statistical reports.

SWEDEN PLANS BIG STATION.

The Swedish Government is to ask Parliament to grant $2,500,000 for the erection of a wireless station powerful enough to communicate with the world at large and United States in particular.

"FATHER OF INTERURBANS" TALKS ON UTILITY SITUATION.

Problem Is National One, Declares Charles L. Henry, Indiana Traction Head.

Public service companies throughout the United States are facing the critical situation of being unable to advance rates in step with increasing costs of material and labor and rightfully must expect co-operation from the public if the service of pre-war times is to be restored, says Charles L. Henry, president of the Indianapolis & Cincinnati Traction Co., known nationally as "the father of the interurban."

Mr. Henry, who is the pioneer in the interurban railway field and chairman of the Indiana Committee on Public Utility Information, says that the Indiana situation is no different from that of any other state, but is national. The Indiana committee, of which he is head, represents the entire group of utilities of that state—electric light and power, electric traction, gas and telephone companies—and like similar committees in other states is attempting to enlighten customers as to the difficult situation.

"Public service companies throughout the United States," Mr. Henry said in a public statement, "are facing a critical situation because of the continually advancing costs of material and labor. The situation in Indiana, where it is almost impossible to advance rates in step with costs, is typical of the national situation.

"Rates for public service are more or less static. They are fixed and they stay fixed until such a time as, after much legal procedure and necessarily slow financial investigation, they can be shown to be insufficient. Service is frequently impaired and the companies suffer losses while the public suffers inconvenience until rates can be readjusted. If it so happens that new rates are made retroactive, as is sometimes necessary, the situation is further complicated.

"The public is usually in no mood to put up with poor services or with facilities that have been distinctly outgrown since war days, and because all other services and commodities have been and are increasing in price, the public is naturally resentful of any new increases.

"On the other hand, public service companies provide common service and rightfully expect some measure of co-operation from the public. They are not in the position, usually, of competing rivals for business who can cut corners and trim edges in every way to make sales. They must serve everybody and serve everybody right.

"They must therefore find sufficient income to meet increasing labor and material costs to maintain and improve pre-war standards of service. At this period their problem is especially difficult because maintenance and replacement materials, as well as operating materials, such as coal, for example, have increased in price.

"We feel sure that when the people understand our situation there will be less impatience with us for service that may sometimes seem inadequate and with the Public Service Commission when it faces the facts and agrees to increase service rates somewhat, and more sympathy and co-operation for our efforts to provide a real public service efficiently and economically."

Ash Handling in Power Plants —Part IV.

Fourth and Last Installment of Series—Vacuum and Steam Ash-Handling Systems—Determining Class of Apparatus Best Suitable

By ROBERT JUNE

The matter of selecting economical systems of coal and ash handling equipment is easily the most difficult problem confronting the power-plant operator. On no other question is it so easy to make a costly and almost irremediable mistake. Nowhere is it harder to be dogmatic in assertion regarding the merits of any particular system for a given set of power-plant conditions.

With a dozen possible systems to choose from, each costing from a few thousands to tens of thousands of dollars, depending upon the size of the plant, the power-plant operator may be excused if he throws up his hands in despair. The situation is not made easier by the practical necessity which he is under to make a choice. The increased cost of labor and coal, together with the uncertainty regarding deliveries of the latter, have made imperative adequate coal storage and economy in the cost of handling coal from the time it reaches the power plant yard to its final disposition in the form of ashes.

In our previous articles, the applications and limitations of various types of chain and belt conveyors, telphers and skip hoists have been discussed. The desirability of separating the coal- and ash-handling systems have been indicated but it remains to examine two of the most important systems of ash disposal—the vacuum and steam jet systems.

Vacuum Conveyors.

In the vacuum conveyor, a line of hard cast-iron pipe is extended from the ash pit, or if there is no ash pit, from a point under the boiler room floor, immediately in front of the furnace, to an air-tight ash storage tank. Vacuum is established in the storage tank by a motor or steam turbine driven centrifgual exhauster. An air washer is installed between the storage tank and the exhauster to remove ash dust from the expelled air.

When the exhauster is in operation a current of air, moving at very high velocity, is produced in the pipe through an intake port at the end of the line. Ashes, when introduced, are whisked through the pipe and into the storage tank.

The advantages of this system are:

(1) *Flexibility.*—The pipe can be carried in any direction, up or down, right or left, with discharge point a considerable distance from boiler-room.

(2) *Adaptability.*—Easily installed in all types of boiler-rooms, old and new.

The disadvantages are:

(1) *Limitations of Service.*—Ashes can only be removed from one furnace at a time, as the opening of an intake near the tank will destroy the velocity at an intake farther away. Only about 2500 to 3500 hp. of boilers can be served by a single system; above this capacity additional complete systems must be installed.

(2) *Leakage.*—Both pipe line and tank must be maintained in an air-tight condition at all times.

(3) *Explosions.*—There is danger of explosion of ash dust and gases in the storage tank. The introduction of water into the pipe line has been tried in an effort to overcome this, but the success of such a means is doubtful, since a sufficient quantity of water to quench the ashes thoroughly will probably prove enough to choke the pipe with wet ashes. Water will also cause trouble by freezing the ashes in the tank in cold weather and packing them so that their removal is difficult in other seasons.

(4) *Maintenance.*—As in all ash removal systems except the skip hoist, maintenance is high on account of the abrasive character of the ashes. Pipe renewals, especially bends, can be expected after 6000 to 8000 tons of ashes have been handled. Exhauster repairs, especially to the impeller blades, are to be expected, due to some ash dust coming through the air washer.

Steam Jet Conveyor.

Like the vacuum conveyor, the steam jet conveyor primarily consists of a pipe line into which the ashes are fed and through which they are transported to a discharge point. The similarity between the two systems is not great, however. In the vacuum conveyor the ashes are moved by suction through the entire length of the pipe line, while in the steam jet conveyor suction is employed only in what is called the suction line immediately in front of the boilers or ash pits.

Suction is created by the action of high-velocity live steam discharge into the center of the pipe-line in the direction of travel of the ashes. The steam discharge tends to create a vacuum behind it, which in turn creates a current of air through the air intake at the end of the line, similar to the action of the vacuum conveyor. The effective suction distance of one steam jet is, of course, limited and if this discharge is exceeded, it is necessary to install booster jets. The discharge of the ashes beyond the steam jet is really an ejection due to the force of the jet actually pushing the ashes through the pipe, hence the effective discharge distance of a steam unit is much greater than its suction distance. In the average system no additional steam jets are, therefore, necessary in the discharge line.

The advantages of the steam jet conveyor are:

(1) *Flexibility.*—Pipe can be carried in any direction. Any type of discharge may be used, as for instance:

(a) Where it is desired to fill a gully or other low ground, the ashes are merely blown from the end of the pipe without any restraint. As the ashes are blown 50 to 75 ft. beyond the end of the pipes, some ash dust will be carried over the neighborhood, even when the most effective water jet is installed in the line.

(b) For loading cars, wagons, etc., a baffle box may be used. Some trouble due to dust may be anticipated with this system, but if properly designed the dust may be so minimized as not to be objectionable in manufacturing districts.

(c) Where an ash storage bin is desired, the most careful attention must be paid to design so that no dust will be discharged with the exhaust steam; no trouble will be caused by water of condensation; no water will be allowed to come in direct contact with the ashes in the bin; ashes will be discharged into the bin without any remaining downward compound of the conveyor force which will cause packing; impact of the incoming ashes must be taken by a suitable baffle as ashes discharged against the bin walls will soon cut holes through them.

(2) *Adaptability.*—Can be installed in practically any plant, no matter how crowded.

(3) *Low Initial Cost.*—Owing to simplicity and freedom from mechanism, this is probably the cheapest effective system which can be installed so far as first cost is concerned.

The disadvantages of the steam jet conveyor are:

(1) *Clinkers.*—Clinkers must be broken to size to pass through intake openings. Under average conditions, burning run-of-mine bituminous coal, this is not a serious disadvantage, as clinkers can usually be easily broken with the hoe. In cases, however, where the ash produced is made up almost entirely of large hard clinkers, steam jet conveyors should not be considered.

(2) *Steam Pressure.*—Not less than 80 lbs. of pressure is required.

(3) *Wet Ashes.*—Generally speaking, wet ashes cannot be handled on account of packing at turns in the line. This eliminates certain types of installations as, for instance, water-sealed gas producers.

(4) *Limited Capacity.*—2500 to 3500 hp. of boilers is about all which can be handled by a single system; above this capacity additional systems must be employed.

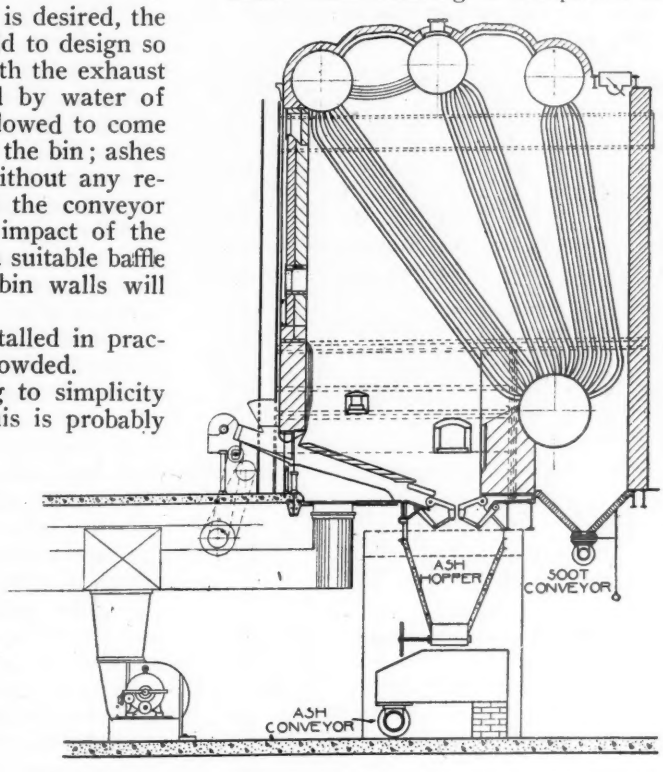
(5) *Maintenance.*—The abrasive character of the ashes render pipe renewals, especially at bends, an expected occurrence after 6000 to 8000 tons of ashes have been handled. In order to cut down renewal expense, elbows are made with removable backs and, where possible, long sweep bends are employed.

(6) *Ash Freezing.*—Ash freezing in storage tanks is to be looked out for in cold weather.

An idea of steam cost for a typical steam jet conveyor system may be obtained from Table I.

As indicative of the labor saving effected by a conveyor of this type, one user reports the elimination of 1 ash wheeler, 1 teamster and 1 horse, at a saving of $12 per day. Conditions are described as follows:

"The only expense for maintenance, after six months' constant operation, was the replacement of the first section, beyond the steam nozzle, which was completely worn out. The conveyor handles the ashes from a battery of five (5) 50-hp. boilers and one 500-hp. boiler. The coal used is a fine dirty slack, stored on the open prairie, and containing, owing to the inclusion of mining machine dirt, about 25% of ash. The ashes are left on boiler-room floor in front of boiler until cleaning is completed and are then put into conveyor, which handles the complete cleaning about 7 minutes. The grade of conveyor pipe line rises about 8% for 200 ft., then 45% for 40 ft., discharging onto an open pile."



Steam Jet Ash and Soot Conveyor Installation for Sterling Boiler and Underfeed Stoker.

TABLE I.

Boiler No.	Distance from ejector, ft.	Steam pressure.	Quantity of ashes moved, lbs.	Time, hrs.	Tons per hr.	Steam used per min., lbs.	Steam used per ton ashes moved.	Cost of steam per ton ashes moved.
1	4	110	300	1	9.00	37.43	249.3	$.068
2	19	109	292	1	8.79	37.10	253.2	.07
3	35	109	284	1	8.46	37.10	274.9	.078
4	52	108	234	1	7.04	36.85	314.0	.088
5	64	109	210	1	6.30	37.10	353.3	.098
Average	34⅘	109	264	1	7.92	37.10	289.0	$.080

DETERMINING CLASS OF EQUIPMENT.

All the important types of coal and ash handling equipment have now been discussed. Regarding the ash conveyor question as disposed

of, let us give a final glance at the problem of making an intelligent selection between flight, pivoted bucket and belt conveyors for coal handling.

Reginald Trautschold is authority for the following table of annual operating costs:

TABLE II.

Annual Operating Costs in Dollars Per Ton-mile.

Equipment.	Fixed charges.	Operating expenses.	Power expenses.
Flight conveyors (including 20% elevation)	$ 17.5 N	$0.55	$5.30 Pc
Belt conveyors (including 20% elevation)	109.5 N	0.15	2.15 Pc
Pivoted bucket carriers (including 33⅓% elevation)	520.0 N	0.40	2.65 Pc

N equals hours per year equipment is in operation.
Pc equals cost of power per horsepower.

As an example of methods of determining by calculation the type of equipment to be installed, assuming that a power plant requires 40,000 tons of coal a year and that the distance from the track hopper or point of delivery to the far end of the conveying system is 440 ft., we have thus 3333 ton-miles per year. Assume, further, that when in operation the conveyor system must handle 80 tons per hour.

It is known that the initial cost of the belt conveyor will be considerably heavier than that of the flight conveyor, but the choice will be governed by consideration of costs per ton moved as well as initial costs.

SAMPLE CALCULATIONS.

(a) *Flight Conveyor System.*—Forty thousand tons annually.

440 ft., 80 tons per hour.

Power cost, 2c per hp.

$$\text{Hours of operation} \frac{40{,}000}{80} = 500 \text{ hrs. per year.}$$

Annual cost (refer to Table II):

$$3333 \times \frac{17.5}{500} = 116.65$$
$$0.55 \times 3333 = 1833.15$$
$$5.30 \times 3333 \times 0.02 = 353.30$$

Total .....$2303.10 or 5.76c per ton.

(b) *Belt Conveyor.*—[Same conditions as in (a).]

Annual cost:

$$3333 \times \frac{109.5}{500} = 1729.93$$
$$0.15 \times 3333 = 499.95$$
$$2.15 \times 3333 \times 0.02 = 153.31$$

Total .....$1403.19 or 3.66c per ton.

(c) *Pivoted Bucket Carriers.*—(Same conditions as (a), except length, which is 220 ft. Service 1667 ton-miles per year.)

Annual cost:

$$1667 \times \frac{520}{500} = 1733.67$$
$$0.40 \times 1667 = 666.70$$
$$2.65 \times 1667 \times 0.02 = 88.35$$

Total .....$2488.72 or 6.22c per ton.

The foregoing examples are, of course, merely illustrative of the principles of calculation. If conditions were changed, the results would not be relatively the same. Such figures alone do not tell the whole story, since it must be remembered that the pivoted bucket carrier could be used for ash handling as well. The one rule, then, is to take a given set of plant conditions and to work out the actual costs of installation and operation for each of all these various types of conveyors, which might be installed. Only by thorough investigation can the proper choice be made.

LABOR AND FUEL SCARCITY HURTS STEEL COMPANIES' OUTPUTS.

Demand for Steel Larger Than Supply, Engineer Tells Jobbers' Association.

Speaking before the Atlantic Division of the Electrical Supply Jobbers' Association in New York City on Feb. 9, George W. Provot, of the United States Steel Corporation, told how the shortage of labor and fuel was curtailing the output of steel products, Mr. Provot said:

"It is not possible for any plant to operate all of its furnaces. The reason is that the companies cannot obtain a sufficient amount of coke. The supply of coke is regulated by the coal output and by the shipping facilities of the railroads. In some cases the mines cannot produce the desired amount of coal because of labor difficulties, and in other cases the mines cannot obtain cars to ship the coal.

"Another situation that is preventing the operation of all the furnaces at the steel mills is the scarcity of labor at present and the uncertainties of labor in the future. The steel mills dare not fire all of their furnaces unless they have the assurance that the furnaces can be kept in operation for long periods of time. To start a furnace is a costly operation. As a general thing, a furnace is operated continuously during two to five years. When the fire is withdrawn the furnace is re-lined. If a furnace is shut down inadvertantly for any unforeseen reason, to remove the charge is a difficult task which, in some instances, requires the wrecking of the furnace, the removal of the charge and the building of a new furnace. Unless the mills can foresee enough labor and coke to keep a furnace in operation through a period of years they dare not fire it.

"As a general thing, the United States Steel Corporation is endeavoring to prevent speculation by keeping the prices of steel stationary and stabilizing the market. Although the employes have been granted a recent wage increase, the steel corporation prefers to absorb the increased expense rather than pass it to the public.

"Although the demand for steel is larger than the mills can supply, very little of that demand is from foreign buyers. The railroads have placed some large orders but they can use much more than they can get. A large proportion of the railroad equipment is so nearly worn out that railroad orders alone are sufficient to keep the mills operating for some time. It is estimated that the mills will need to operate at full capacity for five years in order to supply the present domestic requirements for steel products."

Graphic Method of Keeping Continuous Power-Plant Records

Setting Standards of Coal and Water Consumption—Keeping Operating Performance Visualized—Typical Examples

By ROBERT H. PARSONS

Consulting Engineer, London, Eng.

The importance of economy in the use of fuel need not be emphasized. The cost of coal overshadows every other item of expense in the operation of a steam plant and, in fact, it usually exceeds all other epxenses put together. Hence there is no direction in which a reduction of cost may be more profitably sought than in the economy of coal, for the financial benefit sought of reducing the coal consumption by even a small percentage is very considerable, and is obviously greater than can be obtained by effecting a corresponding saving in any other item. The numerous instruments met with in a modern power-station, such as CO_2 recorders and gas and feed-water thermometers, Lea recorders and, one may almost add, vacuum gauges, have no other function than to assist the engineer in reducing the number of pounds of coal per kw-hr. This object is always before his eyes and yet if one asks him what he considers the coal consumption per kw-hr. of his plant ought to be, it is very difficult to get a definite answer. He knows that the figure varies, not only with the efficiency of operation of the plant, but with the output as well, and he would most likely be doubtful as to whether a consumption of, say, 3.5 lbs. of coal per kw-hr. during a shift on which the output was 10,000 kw-hrs. was better or worse than a figure of 3.25 lbs. per kw-hr. with an output of 15,000 kw-hrs. per shift. This uncertainty as to what constitutes a reasonable coal consumption for any given output is a great hindrance to the improvement of efficiency, as the conclusions which might be drawn from the results of any change of the method of operating the plant are rendered doubtful by the effect exercised upon the consumption by varying loads.

The object of this article is to place before engineers a simple graphic method of keeping a continuous check upon the efficiency of their plant and to provide a criterion by which the performance of the plant may be judged, irrespective of the load which it may be carrying. It will be shown that standards of both coal and water consumption per kw-hr. can be determined for any particular plant, and that the performances on any shifts can be usefully compared either with each other or with the standard, no matter what the outputs per shift may be. Thus the effect of any change in the running conditions, whether intentional or otherwise, can be noted at the end of the shift, and adverse conditions can be discovered and rectified with the least possible delay. No lengthy trials of a new class of coal or an altered method of operating the plant are required to determine whether the change is for better or worse. A correct opinion can usually be formed at the end of the first shift on which the change is made. These advantages alone are amply sufficient to justify the small amount of trouble the method involves, but apart from the continuous graphic check upon the overall efficiency of operation, which is obtained, a most valuable light is thrown upon the conditions obtaining in the plant.

Determining Coal and Steam Consumption.

The standard coal and steam consumption of the station are determined as follows. Dealing first with the coal consumption, a chart is prepared on squared paper with a vertical scale reading in pounds of coal burnt per shift, and a horizontal scale reading in kw-hrs. generated per shift. The latter quantity may be taken either as the aggregate output of the main gen-

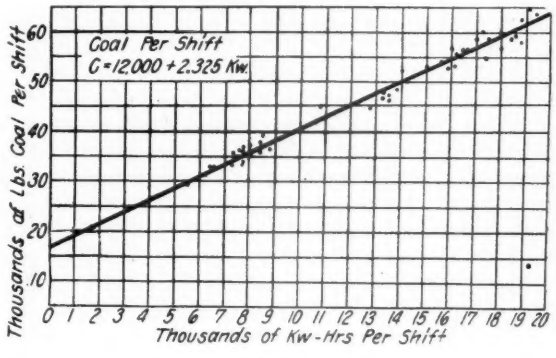


Fig. 1.

erators, or as the net output, as metered on the outgoing feeders. It is generally better to adopt the latter practice, because, after all, it is the function of the station to produce power for sale and the current consumed in the station itself, whether by driving auxiliaries or in conversion or other losses, cannot rightly be considered as part of the real station output. If current is generated for driving auxiliaries or motor-generators it is because it is found cheaper than to adopt alternative methods, and the economy so brought about is properly shown in the reduction of the coal consumptiou per kw-hr. of net output.

Another chart, similar to that just described, is prepared for the steam consumption, the vertical scale in this chart representing pounds of water pumped into the boilers per shift, and the horizontal scale denoting total kw-hrs. generated per shift as before. The most convenient

paper for these charts is quarto size, ruled with half-inch squares, each square being further subdivided into tenths.

At the end of every shift the total coal and the total water consumed are to be plotted on their respective charts over the figure representing the total output on that shift. When a sufficient number of results have been plotted it will be found that the dots on each chart lie about a straight line. The line which lies most evenly among the dots must now be drawn in.

The charts will appear as shown in Figs. 1 and 2. The lines on the charts obviously represent the average consumptions of coal and water respectively which are obtained in the station for any output per shift. They thus form standards against which the efficiency of working may be continuously measured, as no matter what the output may be, if the coal consumption on any shift, when plotted on Fig. 1, is found to lie above the line, it is clear that the performance of the station during the shift was not so good as the average. An immediate inquiry can, therefore, be made into the operating conditions while the facts are fresh, and the same applies for water consumption.

Standards of Efficiency.

As the standards of efficiency, represented by the lines on Figs. 1 and 2, are no arbitrary ideals which are impossible of attainment, but are merely the average working results of the particular station in question, it should be as easy to improve upon them as to fall below them. The effect of establishing such standards is to give the shift engineers something to beat, and the almost inevitable result of checking the daily performance by them is to bring about a higher and more sustained efficiency of the whole station.

Should the coal consumption on any shift be higher than the standard, reference should be made to the chart of water consumption, and if this shows the water consumption per kw-hr. to be normal it is clear that the trouble must be looked for in the boiler-room. It is often convenient, however, to prepare a third chart, upon

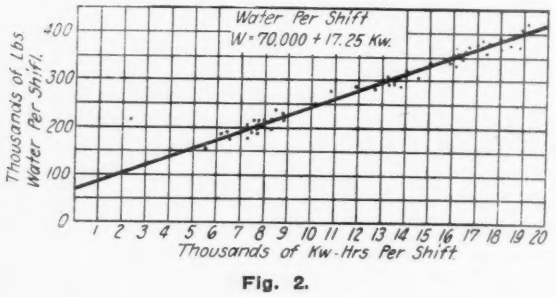

Water Per Shift
W=70,000+17.25 Kw.
Thousands of Lbs Water Per Shift.
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Thousands of Kw-Hrs Per Shift

Fig. 2.

which the vertical scale reads in pounds of water pumped into the boilers per shift. When the figures for these two quantities are plotted on such a chart, it will be found that the points also lie about a straight line, which denotes the average evaporation efficiency of the boilers. The immediate usefulness of this latter chart is to assist in finding the explanation for any unusual circumstance by showing at a glance whether the standard evaporation per pound of coal has been maintained or not. If it has been maintained, and the coal consumption, as shown on the chart corresponding to Fig. 1, is above the standard, then it follows that steam has been wastefully used. If, on the other hand, the evaporation is below the standard, either bad boiler operation or a poor quality of coal is entirely responsible.

As many engineers are more used to the expression of efficiency in terms of pounds of water or of coal per kw-hr. than in terms of total consumption, the charts may be modified if desired so as to present the facts in the more familiar form. To do this, the standard consumptions corresponding to various outputs are read from charts (Figs. 1 and 2) and the figures so obtained are divided by the respective outputs. The results of these divisions are then plotted above the corresponding outputs and a curve drawn through the points in each case. The charts then appear in the forms shown in Fig. 3 (page 313), from which the standard consumptions in lbs. per kw-hr. can be directly read. Similarly, of course, a curve showing evaporation per lb. of coal for various coal consumptions can be prepared from the straight line chart illustrating the total water consumption plotted over total fuel per shift. The question raised above as to whether a consumption of 3.5 lbs. of coal per kw-hr. with an output of 10,000 kw-hrs. per shift was a better performance than a consumption of 3.25 lbs. with an output of 15,000 kw-hrs., can be immediately answered by reference to Fig. 3, so far as the particular station we have been considering is concerned. From this chart it will be seen that the standard performances at the two outputs are, respectively, 3.525 lbs. and 3.125 lbs. of coal per kw-hr., so that at the smaller load the actual performance is better than the standard, while at the greater load it is worse. Thus the consumption of 3.5 lbs. per kw-hr. with an output of 10,000 kw-hrs. indicates that a higher operating efficiency is obtained than when only 3.25 lbs. of coal are used per kw-hr. with an output of 15,000 kw-hrs.

Increased Efficiency by Use of Charts.

The most practical use which can be made of the charts described, particularly of the type illustrated in Figs. 1 and 2, is to keep them on the switchboard and have the coal and water consumption of the station plotted upon them at the end of every shift. By doing this the efficiency of the station working is brought graphically before the eye of the engineer in time for him to look into any conditions which may have brought about a bad performance. If either the coal or water consumption is appreciably different from the standard, a note should be entered on the log sheet calling attention to the conditions of operation, with a view either to repeating them or avoiding them in future, as the case may be. It will almost always be found that the mere fact of the engineers having before them a definite criterion of efficiency will bring about so great an improvement in operation that new and more exacting standards can be established. As such standards are really nothing more than an average of, say, a fortnight's performances, the correction of a standard to correspond with improved operating conditions has never a depressing effect upon the staff, as from

its very nature they always have an even chance of beating it.

It is sometimes considered a defect of such charts that they give no indication of the order in which the records are plotted, and therefore they do not show whether the station is improving or otherwise in efficiency as time goes on. This objection can be overcome in an extremely simple manner, and a continuous curve of efficiency obtained for any station. The method will be described later, as its explanation depends upon an understanding of what the lines which have been considered as standards of efficiency, really mean.

Each line may, of course, be represented by a simple equation which can be determined as follows: Referring to Fig. 1, let the coal consumption per shift be represented by C, and the output per shift by K. The value of C for any point on the line is obviously equal to the height at which the line meets the vertical through O, plus the additional height due to the slope of the line. The first of these quantities is read directly from the scale on the diagram and is 12,000 lbs. for this particular case. It is also seen from the diagram that when, for example, $K = 20{,}000$, the corresponding value for C is 58,500. Subtracting from this latter figure the constant of 12,000 shows that C increases in value by 46,500 for an increase of 20,000 in the value of K, or by 2325 lbs. for every unit increase of K. The total value of C at any point is, therefore,

$$C = 12{,}000 + 2.325\ K \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

This is the equation to the line in Fig. 1 and gives the total coal consumption corresponding to any value at K, that is, output per shift. By dealing with Fig. 2 in an exactly similar manner is obtained

$$W = 70{,}000 + 17.25\ K \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

in which W represents the total number of pounds of water per shift and K is the total output in kw-hrs. as before.

Facts Relative to the Operation of the Station.

These equations bring out certain very instructive facts relative to the operation of the station to which they refer. In the first place, we see from equation (1) that 12,000 lbs. of coal are burnt per shift without any corresponding production of energy, and that an additional 2325 lbs. of coal are consumed for every kw-hr. generated. The constant loss of 12,000 lbs. of coal per shift represents the "stand-by loss" or the fuel required to make up all radiation, condensation and other losses, and to maintain the plant for a shift in a state ready to carry the load. These losses have to be borne whatever the output of the station and are practically independent of it. Thus, however, much coal is burned per shift; 12,000 lbs. of it are used to make good the constant losses and the balance is being usefully burnt in the production of power. Similarly from equation (2) the total water consumption can be regarded as being composed of two parts, namely, 70,000 lbs. per shift used without any corresponding output of energy, and an additional 17.25 lbs. for every kw-hr. produced. As before, the constant of 70,000 lbs. represents stand-by losses, leakages, etc., and remains substantially the same whatever the output of the station. These substantially constant losses of coal and steam must, of course, in the nature of things, increase somewhat with the load, but the plotted results always indicate that such increase is negligible in practice, and that no detectable error arises from treating them as constant. In one case coming

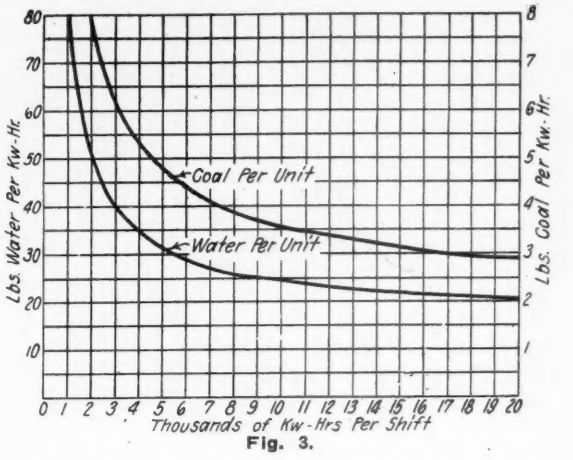


Fig. 3.

under the writer's notice a large steam station was acting as stand-by to a hydroelectric plant and the vicissitudes of operation of the latter caused the steam plant to be called on for anything between 1000 and 60,000 kw-hrs. per day, both extremes being met within a single month. The straight-line law was found to hold over this great range, thus justifying the practical assumption of the constancy of stand-by losses, even under so great a variation of output.

$$C = 12{,}000 + 2.325\ K \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

and $$W = 70{,}000 + 17.25\ K \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

if each is multiplied by the numerical coefficient of K in the other one, is obtained

$$17.25\ C = 207{,}000 + 40.10625\ K$$
$$2.325\ W = 162{,}750 + 40.10625\ K$$

Subtracting the second of these from the first, gives

$$17.25\ C - 2.325\ W = 44{,}250$$

and dividing throughout by the coefficients of C and W respectively gives

$$C = .1348\ W + 2565 \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

or $$W = 7.418\ C - 19{,}030 \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

These two latter equations are identical, but each form is useful for the purpose of bringing out some fact. They could, of course, have been derived directly by plotting the total cost burnt per shift against the total water consumed, in the same way that equation (1) was deduced from Fig. 1.

From equation (3) it is seen that if W were zero, *i. e.*, if no steam at all were to be used per shift, there would nevertheless be 2565 lbs. of coal required to maintain the boiler-house conditions and to keep up steam. It has already been seen from equation (1) that if no kw-hrs. were to be generated, 12,000 lbs. of coal would still be required per shift to make up the stand-by losses. Hence the difference between these figures, namely, 9435 lbs., represents the coal necessary to make good the engine-room losses only, including auxiliaries, etc., if the station were running at no load. An analysis of the results of any power station along these lines cannot fail to be of very great help to the engineer in determining what his no-load losses are

and what part of his plant is chiefly responsible for them. But besides indicating the magnitude and source of the no-load losses, the equations further show the efficiency to which the plant is approximating as it becomes more and more

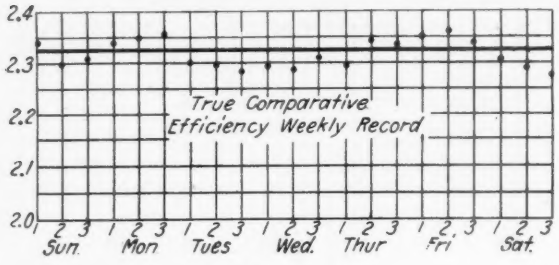


Fig. 4.

fully loaded. If, in equations (1) and (2) the value of K were to be taken as very large indeed, the constant numbers would be negligible in comparison, so that the coal consumption would eventually become 2.325 lbs., and the water consumption 17.25 lbs. per kw-hr. These are the figures to which the curves in Figs. 3 and 4 are tending.

By similar reasoning it will be found that the evaporation figure approaches more and more nearly to 7.418 lbs. of water per lb. of coal as the work of the boilers is increased. These limiting figures can, of course, never be obtained on a finite plant equipped and operated similarly to the station considered, but they show the efficiencies to which such a station is tending when no change is made beyond increasing the load. It is, however, quite true to say that any extra load given to the station can be carried for an expenditure of 2.325 lbs. of coal and 17.25 lbs. of water per kw-hr. of the output in question, so long as the methods of operation remain the same. This deduction is a useful one to make when it is necessary to determine the net cost of carrying any particular load. If, for example, 2.325 lbs. of coal cost 1 cent, the power station in question would lose by paying more than 1 cent per kw-hr. for any power purchased, unless the effect of purchasing was to bring about some saving other than that of coal.

The fact that the failure of charts of the types shown in Figs. 1 and 2 to indicate whether the earlier records plotted were better than the later ones or, vice versa, was frequently looked upon as a drawback, has been pointed out. There is no doubt that a chart which will show graphically the trend of efficiency so that a progressive increase or decrease will be brought clearly to the engineer's attention, is often very useful. Fortunately, also, it is particularly simple to construct when once the equations to the stations have been determined. Referring once more to equation (1), we see that if there were no constant term, the coal consumption would be 2.325 lbs. per kw-hr. for all outputs. Hence, if, when the figures come in at the end of every shift the engineer first subtracts the constant from the actual consumption and then divides the remainder by the electrical output, he will always get 2.325 if the standard efficiency of the station is maintained. We may, therefore, prepare a chart (Fig. 3), in which the horizontal scale represents successive shifts and the vertical scale reads in pounds of coal per kw-hr. A heavy straight line is drawn horizontally across the chart at the level corresponding to 2.325 lbs. per kw-hr. The coal consumption per kw-hr. (calculated after the subtraction of the constant from the gross amount) can then be plotted on the chart shift by shift, and when the records are joined by a continuous line a graph is obtained illustrating in the clearest manner how the efficiency of the station compares with the standard as time goes on. An exactly analogous method can be adopted to obtain a continuous graphic record of the steam consumption of the station per kw-hr., or of the evaporation per lb. of coal. With such records a very interesting and instructive comparison may be made between the improvement in operating efficiency obtained in the engine-room and boiler-room, respectively.

In conclusion, in the accompanying table are given a few equations obtained from the records of actual power stations. They must not be taken as examples of commendable economy, for in only one station is a really good efficiency shown. Some are indeed very bad, as is only to be expected since they are based upon log-sheet records made while the station was not under critical observation, and it was the desire to improve the efficiency which led to the analysis of the records. In all cases the equations refer to the performances "per shift" and the output signifies the gross output of the main generators.

Station.	Equations.	Notes.
A.	$C = 17{,}300 + 4.846\,K.$	Fuel, low-grade lignite slack. This plant was a stand-by for a hydro-station and output varied from 1000 kw-hrs. to 60,000 kw-hr. per day. No water consumption figures available.
B.	$C = 12{,}500 + 3.75\,K.$ $W = 66{,}660 + 26.923\,K.$ $C = 3214 + .1393\,W.$ $W = 7.179\,C - 23{,}077.$	Fuel, fairly good slack. Output 10,000 to 20,000 kw-hrs. per day. The steam consumption in engine room is very high.
C.	$C = 21{,}000 + 2.9\,K.$ $W = 110{,}000 + 17\,K.$ $C = 2235 + .17\,W.$ $W = 5.86\,C - 13{,}103.$	Fuel, low-grade lignite. Only one generator was running during the whole period. The steam consumption of this generator was measured as $S = 48{,}000 + 13.35\,K$: per shift during the period, showing heavy steam consumption of auxiliaries, etc. Output of station 20,000 to 45,000 kw-hrs. per day.
D.	$C = 10{,}000 + 2.06\,K.$ $W = 60{,}000 + 15.3\,K.$ $C = 1921 + .134\,W.$ $W = 7.42\,C - 14{,}272.$	Fuel, about 12,400 B.t.u. per lb. Every care taken to economize heat and steam. Output 20,000 to 40,000 kw-hrs. per day.

JAPANESE ENGINEER GIVES TALK BEFORE NEW YORK SOCIETIES.

At the February meeting of the New York Section of the Illuminating Engineering Society and the Society of Gas Engineering, of New York, held at the Consolidated Gas Co. building, New York City, on Feb. 19, Motoo Uchisaka, secretary of the Illuminating Engineering Society of Japan, read a paper on "Artificial Lights and Their Fixtures in Japan," the paper being illustrated with lantern slides, showing both ancient and modern fixtures, among them some examples of Japanese art.

NATIONAL PUBLIC WORKS BUREAU PLAN MEETS WITH FAVOR.

Convention in Washington Attended by 95 Delegates Representing 90,000 Technical Men, Urges Adoption.

Delegates, 95 in number, representing engineering and technical associations with a combined membership of 90,000, met in Washington, D. C., Jan. 13 and 14 for the second convention of the National Public Works Department Association. This association, originally formed at a meeting in Chicago last April, has as its main purpose the formation of a new United States government department of public works.

At the organization meeting in Chicago it was pointed out that government construction and building work and the maintenance of public buildings was handled in generally a haphazard manner with many different government departments responsible for such a condition.

Federal buildings, if they are used as a combined custom house and postoffice, or if they are used for the purpose of holding United States courts as well as housing the postoffice are under control of the treasury department. If the postoffices are used solely for postoffice purposes they are under control of the postoffice department. Other government buildings are under control of the war department, the interior department and in fact every government department has more or less to do with the structures built for or in use by the United States government.

Would Have Control at All Buildings.

The primary idea in the organization of the National Public Works Department Association was to take such steps as would result in the formation of a new governmental department or bureau, that would have supervision and control of the construction of all buildings to be erected for the government and of the maintenance of such buildings after their construction and occupancy by whatever department they were built for.

When the convention was called to order at the Willard hotel a roll call of states showed that some effective work had been done in the educational campaign for the new department between the time of the organization in Chicago and the Washington convention. Delegates reported that they had found most of the congressmen and senators from their respective states in favor of the creation of the new department.

The Jones-Reavis bill was discussed and several objections raised to it, especially to the provisions transferring the board of education to the department of labor. A resolution was adopted by the convention calling attention to the fact that Section 3 of the Jones-Reavis bill, transferring the board of education to the department of labor, has nothing to do with public works and that the only reason for the section being in the bill is that some departmental disposition must be made of the non-engineering bureaus in the interior department, the board of education being such a bureau.

An address prepared by Gov. Frank O. Lowden, of Illinois, on "What a Department of Public Works Has Done for Illinois," was read by Isham Randolph, of Chicago. At the evening session speeches were made by Congressman C. Frank Reavis, of Nebraska, and Brigadier-General R. C. Marshall, chief of the construction division of the army. Both men spoke in favor of the establishment of a department of public works.

Urges Stoppage of Government Leaks.

In opening the meeting M. O. Leighton, who acted as chairman, delivered an address in which he urged that government leaks be stopped. Mr. Leighton, who is chairman of the National Service Committee of Engineering Council, at Washington, said in part: "Our government has always been wasteful in the conduct of its business. This has not been the result of any wrongful intent. Throughout a long period of years it has been accepted by the majority and the occasions have been sporadic when much thought has been given to it. Wealth usually begets thoughtlessness as to small wastes.

"And this was particularly true with respect to government expenditures when we lived under an indirect system of taxation. But now our system of taxation is direct. Every individual of more than nominal earning capacity is presented with a bill by the internal revenue office for his share. And when our annual peace time budget runs up to $5,000,000,000 we begin to think about the waste.

"We are asking the government for a business-like organization, asking them to co-ordinate the functions so that the processes of government business shall dovetail. Cut out the wastes and duplications. Abolish the rivalry between departments.

"When this organization was set up at Chicago few of us had an adequate idea of the possible scope of this movement. We saw at Washington a loose and inefficient public works organization, divided and subdivided into many different provinces. As technical men we knew how organically wrong that was. Of the wastes and inefficiencies we were well aware. With the necessity for a co-ordinated structure, by virtue of which the technical and semi-technical fields of the government could be rendered efficient and business like, we were profoundly impressed. But that our efforts, our idea, our legislative bill would become the corner stone of a structure embodying efficiency in all departments of government we could hardly foresee. As an organization our effort is still focused on a department of public works and that alone. But we realize that with that principle established, reform in other provinces of government business activity will occur by the mere logic of events.

"This is the reason why our project for a department of public works strikes straight home to the business man, the manufacturer, the contractor and the merchant, all of whom are represented in our convention."

Delegates Urge Views on Congressmen.

During the sessions of the convention delegates from the different states visited their representatives in Washington and urged immediate action on the proposed legislation but it was reported that little headway was made as

the congressmen would not promise to add new legislation to the already crowded calendar.

The last matter take up by the convention was the question of finances. It developed that the societies represented in the organization had made very small contributions to its support and that it had been supported by the contributions of individuals. It was recommended that the participating societies assess each of their members $1 for the maintenance of the association.

The Committee on Organization, of which Calvin W. Rice, of New York, was chairman, recommended that the scope of the appeal of the association be enlarged to include the business, professional and social bodies and that all such activities be accorded executive representation in the movement. It was also suggested that a state committee be formed in each state.

Committee chairmen were as follows: Credentials, N. B. Williams, New York; Resolutions, George B. Walbridge, Detroit; Nominations, James H. Herron, Cleveland; New Organization, Calvin W. Rice, New York; Text of Bill, Gardner S. Williams, Detroit.

GEORGE A. McKINLOCK GIVES VIEWS ON ECONOMIC CONDITIONS.

Confident Present Unrest and Difference Between Prices and Values Are Problems That Will Eventually Be Worked Out.

Commenting on business conditions, particularly those affecting high prices, George A. McKinlock, president of the Central Electric Co., Chicago, recently made the following statements which reflect emphatically the necessity for reaching sound economic conditions in this country. In part he said:

"I do not believe we can make any appreciable headway in this subject of high prices, which is one of the biggest problems we have to face today, until the war is out of the way. Manufacturers and producers as yet are uncertain what will come out of this peace and consequently cannot plan ahead any program of operation.

"It is intimated the Senate will not ratify the League of Nations covenant or the peace treaty and that President Wilson intends to canvass the country. The Republicans give every indication of preparing to contend with him, and Germany gives indications of its old-time obstinacy. There is practically nothing coming from France and probably there will be very little for some time; in Great Britain there is unrest, as is shown by the troubles incident to demobilization of the army.

"In our own country there is hardly a labor organization, a commercial or industrial interest that is not demanding what appears to conservatives to be the unrealizable. Where are we to look for the solution of these problems and how can one predict the future as regards high prices and the way to reduce them? It is a question of the difference between prices and values, and I think if we can answer this we will get started on the solution of the problem.

"Present prices are inflated, according to the old standards of value, but the old standards of value have been swept away and we are trying to get new standards. It seems to me that the subject is too big and complex for us to expect an immediate solution.

"The monetary unit is a standard of measurement, but while its period of adjustment is taking place, everything will have simply to wait patiently for things to happen, and I feel confident that things eventually will work out satisfactorily. There must be a period of several years, however, before we can expect to see economic conditions again as sound as they were in prewar days. I am heartily in favor of any movement to reduce the high prices. The excess profits tax should be abolished quickly."

AMERICAN ELECTRICAL POLICIES ARE ADOPTED BY ENGLAND.

Department of Commerce Makes Report on Industrial Situation in Great Britain.

It is estimated that the electric power industry in Great Britain is wasting 55,000,000 tons of coal annually, according to a report on "British Industrial Reconstruction and Commercial Policies," just issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce. The cause of this waste lies largely in lack of centralization and standardization. "In the area of London alone," says the report, "are 70 authorities that supply electricity to the public, owning 70 generating stations, with 50 different types of systems, 10 different frequencies, and 24 different voltages."

The average generating capacity of the 600 establishments in England that sell electric current is only 5000 hp. each. This is about one-fourth the capacity of a generating plant of economical size. So unorganized is the whole electrical industry that "one cannot purchase a simple electric bulb without specifying the particular type of socket" in which it is to be used. There is a strong movement in England today to divide the entire country into 16 power zones under the control of the Government, and gradually to replace existing plants by 16 superpower stations, capable of supplying industrial power to the whole of England. This movement is the outgrowth of the conviction on the part of many officials that the electrical industry is the "key industry" upon which depends Great Britain's future position in the trade of the world.

The actual progress being made in industrial reconstruction is also discussed in this report by the author, Trade Commissioner Fred W. Powell, who spent six months in England studying these transformations at first hand. Mr. Powell shows just how these changes are being wrought in various branches of British industry and sums up the situation by saying, in effect, that "the American idea is abroad in the land." Standardization, scientific management, industrial research and the elimination of waste are to the fore. Publishers are selling efficiency textbooks, manufacturers are making efficiency tests, and the services of efficiency engineers are in demand.

The old regime of "excessive individualism" which has so long been a prominent feature of the British industry, is giving way before the new situation that has arisen since the war. The

official encouragement which has been given to the growing tendency toward the formation of trade associations and combinations is no longer needed. Fearful of the people's interests, the Committee on Trusts of the Ministry of reconstruction has proposed measures to obviate the disadvantageous features of such combinations, and the Government is planning protective legislation.

The report discusses British Government policy as it has expressed itself in recent pending and proposed legislation, particularly with reference to trade-marks and patents, anti-dumping laws, encouragement of industrial research, protection of key industries, and the doctrine of imperial preference. These policies are to some extent the outgrowth of the shifting of the market for British goods as a result of the war. Formerly western Europe was Britain's best export field but, while the need of manufactured goods in this market is enormous, until the economic situation becomes again stabilized, western Europe may be expected to attract foreign investments in preference to foreign goods. This makes it necessary for England to cultivate to a greater extent than ever before her trade with distant parts of her empire and also to extend her trade in South America and in the Far East.

"It is doubtful," says Trade Commissioner Powell, "whether the best informed person knows to what extent the industries of Great Britain are prepared to reassert themselves as factors in world trade." But this uncertainty is likely to be dispelled early this year, when three great industrial fairs are held, one at London, another at Glasgow, and a third at Manchester, Birmingham, at which all the leading industries of the country will be represented at their best.

The report is "Special Agents' Series No. 193," and can be obtained at 10 cents a copy from the Superintendent of Documents, Government Printing Office, Washington, D. C., or from any of the district or co-operative offices of the Bureau of Foreign and Domestic Commerce.

WOMEN WORKERS EXCEL IN MAKING SMALL PART APPLIANCES.

That women workers who engaged in electrical work during the World War will remain in the industry is indicated by information gleaned by Mrs. Anna Lalor Burdick, special agent for trade and industrial education of girls and women, Federal Board of Vocational Education.

"Women's small and agile hands are especially adapted to the work of certain industries," says Mrs. Burdick in discussing her work. "Women make and assemble the delicate parts of adding machines, office appliances, Mazda lamps, electric light equipment and appliances. In 1914 five-eighths of the employes of the Waltham watch factory were women. It is surprising to know that the typical watchmaker of the United States is a 19-year-old girl. Before the war there were only foremen in all industries where women were employed. Since the war there are both the instructional and production forewoman in all women-employing industries."

LIVE TIPS FOR MANUFACTURERS EXPORTING TO FRANCE.

Good advice to American exporters desiring to develop their trade with French customers is given by the American Consulate-General in Paris as follows:

"An American firm to establish itself in France should grant a sole agency on a strictly commission basis to a resident agent providing, in certain cases, a local stock at the risk and for the account of the manufacturer, with direct invoicing by the manufacturer to the purchaser, delivery of invoices and collection of drafts, checks, etc., to be effected by the agent. The firm should deliver all goods free of charges (c. i. f.) direct to the purchaser, prices being quoted to cover all charges as above. The manufacturer must remember that, according to French business ideas, an agent is practically a traveling salesman, entrusted with all France as his territory, and working for a commission."

Photograph Demonstrates Wonderful Growth of Electrical Trade in 35 Years.

Reminiscent indeed, and highly indicative of the wonderful strides made in the development of electricity in the past 35 years, is the picture shown above. The picture shows the office force of the Edison Machine Works, when the plant was located on Goerck street, New York City, in 1885.

This plant was used prior to the establishment of the Edison General Electric Co. plant at Schenectady, N. Y., now the General Electric Co. which now has an office force numbering thousands at the home office, as well as thousands of more in branches all over the world. Compare this to the little group above who handled the office business of the Edison Machine Works in 1885 and an idea of electrical development growth can be realized.

In the picture above No. 1 is James Carr, an erector, whose present whereabouts are unknown. No. 2 is R. T. Lozier, an Edison pioneer, now located at 32 West 40th street, New York City, who when the picture was taken was secretary to Charles Bachelor, manager of the plant. H. A. MacLean, another Edison pioneer, who was chief clerk in the Edison office in 1885 and is now in the machinery business in New York. A third Edison pioneer is No. 4, E. J. Berggren, then bookkeeper of the machine works, now an auditor for the General Electric Company. No. 5 is W. Scott, office clerk, present whereabouts unknown. No. 6 is J. R. Campbell, Edison pioneer, now living at Bogota, N. J., and who, in 1885, was the works' stock clerk. No. 7 is W. M. McDougal, superintendent of works, who has since died.

The original photograph is the property of Mr. Campbell and was sent to the Electrical Review by Mr. Lozier, who obtained it from Mr. Campbell.

LETTERS TO THE EDITOR.

The Late Professor H. S. Carhart.

To the Editor:

Many scientific men and electrical men of the older generation will regret sincerely the death of Dr. Henry Smith Carhart at his home in Pasadena, Cal., on Feb. 13 at the age of seventy-six. From 1873 to 1886 Dr. Carhart was professor of physics in Northwestern University at Evanston, Ill. During this time he became especially interested in electricity and he contributed various articles to the American Electrical Society, of which he was a member and which, between 1874 and 1881, was the representative national electrical society of the United States, having its headquarters in Chicago. One of these articles was on "Atmospheric Electricity." In relation to this paper, when meeting its author at the Paris Electrical Exposition of 1881, the late Sir William Preece said that it was the best paper on the subject that he had read.

In 1881 Professor Carhart exhibited before the then newly formed New York Electrical Society a set of Crookes tubes. This meeting was held in Cooper Union and there was a large audience present. It was on this occasion that Professor Carhart met Thomas A. Edison for the first time. The inventor promised to send the lecturer a dozen of his incandescent lamps, which were then, of course, a great novelty. Edison was true to his word, and these lamps were received by Professor Carhart in Evanston about the last of May, in 1881, and were perhaps the first electric incandescent lamps that ever came to Chicago or vicinity.

Professor Carhart had no dynamoelectric machine, but he did have a battery, imported from London, that would light the lamps, and he exhibited them a number of times. These lamps were not provided with sockets but had two thin copper wires protruding at the smaller end, and by these terminals Professor Carhart wired them in parallel on a board for exhibition purposes.

A graduate of Wesleyan, Professor Carhart gave his life to the teaching profession. He was appointed professor of physics in the University of Michigan in 1886 and became emeritus professor of physics in that institution in 1909, when he retired from active work. He was a man of rugged honesty and, although he attained international prominence as an electrical scientist, he was ever simple, unaffected and straightforward. He wrote much on technical subjects. To the Twentieth Anniversary Number of the *Western Electrician*, published on Sept. 28, 1907, he contributed, at the request of the editor, an interesting article on "Electrical Engineering Education." In the course of this review he made this statement:

"In the final analysis something more must be added to educational attainments to make a successful engineer. Engineers, like poets, are born, not made. To education must be added character; to character, tact in dealing with men; to tact, originality in conception of design; and to originality, a calm judgment that reaches the wisest solution of an engineering problem under given conditions."

No doubt many tributes will be made to the memory of Dr. Carhart as an educator, a scientist and a man. I thought it would be particularly interesting to point out, what may not be generally known, that Professor Carhart was one of the first, if not the very first, to exhibit Edison electric incandescent lamps in Chicago and vicinity.

WILLIAM E. KEILY.

Chicago, Feb. 16, 1920.

History of Early Fuse Plugs.

To the Editor:

In your issue of Jan. 3, 1920, you publish a very interesting article entitled "A History of the Renewable-Fuse Industry." In it, it is said, "the earliest form of inclosed fuse was the Edison plug fuse."

I think that this is in error. The earliest form of inclosed fuse was devised by the writer some time prior to the advent of the porcelain cup and in fact before porcelain came into use for electrical purposes.

It consisted of a rectangular wooden box of a size to fit on the top of the wooden moldings used as conduits for the electric circuits. It had a cylindrical cup center and a circular wooden cover. On diametrically opposite sides of the central cup were placed two brass springs, the electric circuit being opened and the ends connected to these springs. On the base of the cover was placed two corresponding springs, both sets of springs being of such a shape that when the cover was put into place the springs on the cover snapped into close contact with the springs in the box, joining the ends of the springs. On the cover was soldered a short length of lead alloy fuse wire, which, when the cover was snapped into place, completed the wire circuit. When, for any reason, the fuse link was melted by excess current, the cover could be removed and another substituted therefor. The fuse link was at all times inclosed in the interior of the box container.

These inclosed fuses were made by the Consolidated Electric Light Co., the forerunner of the old Sawyer-Man Co., and were first installed in the Mutual Life Building in New York.

E. R. KNOWLES, C. E.

New York, N. Y., Jan. 28, 1920.

WIRELESS "CALLING UP" SYSTEM.

A new wireless "calling-up" system intended mainly for saving life at sea has been devised by the Marconi Co. and was recently demonstrated at Chelmsford. The device will enable a ship in distress to automatically ring alarm bells on board any vessels within range and will do away with the necessity for an operator to be always on duty. The apparatus consists of an automatic transmitter, which will send out a special signal with accuracy, and a reliable receiver which will respond to this signal, and this signal only. It will ensure general and immediate attention being given to emergency calls, such as "S.O.S." and "T.T.T.," the ice warning. The device was used, it is stated, during the war for exploding mines and its action was illustrated at the Marconi Works on Jan. 15, gunpowder being fired by wireless from a station 30 miles away.

Editorial Comment

Two-Fold Purpose of Synchronous Motors

Correction of power-factor is a time-worn problem, a problem that has forced itself to the fore ever since alternating current became general. Of course, power-factor and the effects of low power-factor become more objectionable and of greater moment in certain instances; for example, with electric furnaces where the current is heavy, secondary leads long and improperly arranged. However, the deleterious effect of power-factor is always with us so long as the power-factor is low, whether or not the objections become crucial or not, in the form of interference with voltage regulation, reduction in capacity of generating, transmitting and transforming apparatus.

Of the common causes of low power-factor lightly loaded induction motors and transformers are probably the most predominating. The power-factor of any induction motor is low, that is to say, is not much better than 80% when fully loaded. It is lower still when lightly loaded. It is thus seen that low power-factor is a characteristic of the induction motor, an inherent characteristic. Unfortunately, it seems as if one of the inherent characteristics of the industrial manager purchasing induction motors for his plant is to purchase motors too large for the job, looking, no doubt, to future expansion; the result is that the power-factor of induction motor installations is proverbially and invariably low. It is because it is found that prevention is better than cure that the synchronous motor is rapidly taking the place of the induction motor even in such comparatively small capacities as 75 kw.

The synchronous motor possesses the inherent characteristic of variable power-factor, from zero lagging, through unity, to almost zero leading, depending upon the excess of field ampere-turns over those required for a motor terminal voltage approximately equivalent to the voltage of the supply circuit. Employing a synchronous motor instead of an induction motor immediately solves the power-factor so far as the individual motor power-factor is concerned. This is solving the power-factor bane by prevention. By employing a synchronous motor having greater capacity than actually needed to replace its induction motor equivalent, the low power-factor due to induction motors or groups of induction motors on the same system can be corrected for. This does not occur in any case when operating the synchronous motor at unity power-factor because the effect of unity power-factor alone lessens the effect of low power-factor elsewhere. To this extent is low power-factor alleviated by a cure.

In this issue there appears an article describing the electrical features of a large cold-storage warehouse in which are installed 2250 hp. in synchronous motors, composed of three 500, two 300 and two 75-hp. units. This installation was made during the war, when fuel conservation was imperative, when machinery and equipment were factors in winning the war, and the synchronous motor was adopted in preference to the induction motor because it accomplished just these things. The war is over, but the need for efficiency is with us still. The objections of low power-factor, given such prominence during the war, are just as great, just as prominent, and just as easily remedied today. For correcting and for preventing low power-factor one looks for the synchronous motor to come to be employed more and more.

Metering Power-Plant Performance

A visitor to one of the large central stations was asked what had attracted his attention most. The visitor was an architect, and accustomed to viewing proportions. What struck him most, he said, was the large expanse of boilers in the boiler room as compared with the relatively small volume and space required by the turbines. The criticism was well taken, although the discrepancy is not nearly so great when the space occupied by the ash pits are allotted to the total boiler-room space, and the auxiliaries and condensers to the turbine space. The second criticism made by the visitor was that he had been surprised to find such complete metering on the electrical side, while the boiler-room side was practically unmetered. The visitor in this case, too, showed great observation and a good judgment often lacking among the plant engineers themselves.

The use of larger boilers, units of 2400 boiler hp., increased rates of evaporation so that a given heating surface is today evaporating twice and three times the amount of water as was customary not many years ago, and the application of heat-saving equipment for reducing heat losses and returning as much heat as possible to

the boilers have done much to reduce the discrepancy between the size of the boiler room and turbine room, but until our knowledge of the art grows immensely, this will continue to be the case.

As to why the electrical end of the steam-electric station should be favored with the majority of the metering, there are many reasons. The electrical instrument is comparatively inexpensive, easily applied and electricity offers a convenient and compact method of measuring such properties as speed and temperature, pressure and rate of doing work, etc., that the electrical instrument has gone forward while instruments using other forms of energy have gone ahead less rapidly. Another reason is that such matter as coal and water, steam and air are not easily measured commercially, nor has the need for measuring them always been, nor is yet, fully appreciated. And then, the boiler room so often fails to receive the attention it deserves.

Power-plant instruments are installed, primarily, to indicate what the station is doing. It is just as important to know how much coal is being burned at the ingoing end of the station as the amount of electricity that is going out from the other end. With these two factors known, the over-all efficiency of the station can be derived. It is necessary to know what you are doing before you can know with certainty if you can and if you are improving it.

But it is not enough to know what a station is doing. It is just as important to know how it is being done. Perhaps it is more important to know this latter, since if each step in the process of power plant operation is known, the over-all efficiency will take care of itself. On the other hand, the correlation of the individual processes is tiresome and takes time, so that the over-all economy is a useful index to daily and hourly performance.

The efficiency with which the coal is being turned from chemical to thermal energy, as by the CO_2 recorder, must be known if the operation is to be accomplished uniformly and efficiently. The efficiency of heat absorption of the furnace gases by the boiler must be watched, as shown by steam-flow or feed-water meter and stack thermometer, if soot on the outside and scale on the inside of the heating surfaces are not to work havoc with economy. And so it goes, each process of energy production and energy transfer should be known, and if each is at maximum efficiency, the over-all efficiency will take care of itself.

Unfortunately, many of the smaller plants believe they cannot afford to install instruments, presumably basing their belief upon the pre-war cost of coal. How many instruments to install and what instruments to install, depends upon what economies those instruments will bring about. A wheelbarrow whose capacity is known and a water scale may suffice for one plant, while meters for the coal, the water, the steam, the stack gases, and so on, may be a good investment for a larger plant.

Instruments in the boiler room are installed for one reason only—to save money. They can accomplish this only when they are used. An instrument that pays for itself and then pays a dividend is a good investment. An instrument installed but is not used because it does not work or because the engineer does not know how to use it or interpret it, is a liability instead of an asset. We want people to realize that it is not the instruments but their wise utilization that spells economy and money saving.

Revising the Electrical Code

In the twenty-third year of its existence the National Electrical Code is showing renewed vitality and progressiveness that should give it greater prestige than it has ever enjoyed. The vigor that the Code has maintained throughout its long career is due to the fact that every two years it has had injected into it new blood in the nature of a more or less complete revision or rejuvenation. Thus the Code has been kept fairly abreast of current electrical construction practice. The revision of 1920 promises to be more thorough and important than any previous one, hence the statement at the opening of this paragraph.

The Electrical Committee of the National Fire Protection Association, which is the body responsible for revising the Code, last year adopted a more systematic procedure as to revision, the effects of which are evident in the recent reports of most of its subcommittees. A summary of these reports begins in this issue so that those interested in the Code revision may make themselves familiar therewith before the final meetings next month. Notable in the proposed changes are the rules recognizing varnished-cloth insulation for cables, the entire new rules introduced on elevator wiring and low-voltage isolated farm plants, and the important revision of the rules on grounding, motor wiring and outside wiring.

In effecting this year's revision, it is hoped that the Electrical Committee will take special pains to eliminate conflicts, not only between the various recommendations of its subcommittees but also those remaining in the present Code. Also more care should be exercised in editing the new edition of the Code and in indexing it.

Current Events

Meetings in the Industry—S. E. D. to Broaden Activities —Cleveland to Hold Electric Show—New Electric Truck

A. I. E. E. CONVENTION CONSIDERS POWER AND MEASUREMENTS.

Economical Power Supply, Electrical Communication and Test Measurements, Principal Topics at Largely Attended New York Meeting.

That the attention of electrical engineers is being concentrated upon the economical supply of power was evident from the keen interest taken in the symposium on this subject which formed one of the leading features of the eighth annual midwinter convention at the American Institute of Electrical Engineers which was held at the Engineering Societies building in New York City on Wednesday to Friday of this week. This convention, in point of attendance and discussion of papers, exceeded any similar gathering of previous years.

The first technical session was opened on Wednesday evening by President Calvert Townley, who in an opening address dwelt on the variety of important topics now interesting to the electrical engineer and especially the matter of economical power supply. P. S. Millar, New York City, presented a paper on "Daylight Saving," which gave a critical study of the effects of this measure on the output of lighting companies and reviewed the principal advantages and shortcomings of this practice, pointing out the fact that the economic losses probably outweigh the gains. A paper on "Essential Statistics for the General Comparison of Steam Power-Plant Performance" was presented by W. S. Gorsuch, New York City; this paper is reproduced on other pages of this issue. The final paper at this session was entitled "Standard Graphic Symbols" and was presented by E. J. Cheney, Albany, N. Y.; it offered symbols for adoption as standard in wiring and circuit diagrams.

The entire session on Thursday morning was devoted to the symposium on "Economical Supply of Electric Power for the Industries and the Railroads of the Northeast Atlantic Seaboard." Nine papers were presented on various phases of the subject as follows: two papers by W. L. R. Emmet and J. F. Johnson, dealing with large steam turbines; two papers by H. G. Reist and F. D. Newbury on large alternating-current generators; a paper by W. B. Potter on electric traction developments; two papers by Philip Torchio and Percy H. Thomas on the general consideration in economical power production from water power and steam super-power systems; two papers by W. D. A. Peaslee and A. O. Austin dealing with high-voltage transmission and insulators for this service. All these papers were comprehensively discussed.

At the afternoon sessions which were held simultaneously in different rooms, the electrical communication session listened to two papers on "Printing Telegraph Systems" by J. H. Bell, and "Maximum Output Networks for Telephone Substation and Repeater Circuits." These papers gave the most recent developments in these lines and brought out interesting features whereby the capacity of both telegraph and telephone systems has been very extensively increased, in the latter case by the use of repeater equipment. At the measurement session held at the same time three papers were presented as follows: "A Method of Separating No-Load Losses in Electrical Machinery," by C. J. Fechheimer; "Inherent Regulation of D-C. Circuits," by A. L. Ellis and B. W. St. Clair; "Measurements of Projectile Velocities," by P. E. Klopsteg.

At the Friday morning session two papers dealing with galvanometers were read as follows: "A New Form of Vibration Galvanometer," by P. G. Agnew; "Precision Galvanometer for Measuring Thermo E.M.F.'s," by T. R. Harrison and P. D. Foote. The third paper presented at this meeting was entitled "Notes on Synchronous Commutators," by J. B. Whitehead and T. Isshiki. On Friday afternoon the final session was held at which were presented two papers. The first of these was entitled "Oscillographs and Their Tests," by A. E. Kennelly, R. N. Hunter and A. A. Prior. The other paper was on "The Accuracy of Commercial Measurements," by N. B. Brooks.

Special arrangements were made for inspection visits to many points of electrical interests in and near New York City and beginning Wednesday afternoon a large number of members and visitors of the convention availed themselves of the opportunity to visit the laboratories of the Western Electric Co. At other times other laboratories, power plants and other places of interest were inspected. The arrangement of the program was such that those not specially interested in the measurement sessions were enabled at that time to visit some of the power plants, while those not deeply interested in the power sessions availed themselves at that time to visit the laboratories. Only one special entertainment was provided—a dinner-dance at the Hotel Astor on Thursday evening.

ASSOCIATED MANUFACTURERS WILL MEET NEXT MONTH.

Section Meetings Will Precede Annual Session of Electrical Supply Men.

The fifth annual meeting of the Associated Manufacturers of Electrical Supplies will be

held at the Waldorf-Astoria Hotel, New York City, on March 18, opening with a business session at 2 p. m., at which time the election of governors, presentation of annual reports and transaction of other business will take place. The annual banquet and social session will take place at 7:30 p. m.

Preceding the annual meeting will be the various section meetings, on March 15, 16 and 17, held in the association rooms and in the Old Colony club rooms, Manhattan Hotel, directly opposite the association headquarters.

The schedule of section meetings follows:

Monday, March 15.—Industrial Lighting Section, 10 a. m., Association rooms; Signalling Apparatus Section, 2 p. m., Association rooms.

Tuesday, March 16.—Outlet Box Section, 10 a. m., Old Colony club; Line Material Section, 2 p. m., Old Colony club; Snap Switch Section, 10 a. m., Association rooms; Molded or Formed Insulation, 10 a. m., Association rooms; Lamp Receptacle and Socket Section, 2 p. m., Association rooms; Air Circuit Breaker Section, 2 p. m., Association rooms; Attachment Plug Section, 4 p. m., Association rooms.

Wednesday, March 17.—Fan Motor Section, 10 a. m., Old Colony club; Rigid Conduit Section, 10 a. m., Old Colony club; Nonmetallic Conduit Section, 2 p. m., Old Colony club; Armored Conductor Section, 4 p. m., Old Colony club; Panelboard and Switchboard Section, 10 a. m., Association rooms; Fuse Section, 10 a. m., Association rooms; Knife Switch Section, 2 p. m., Association rooms; Electrical Porcelain Section, 2 p. m., Association rooms.

ELECTRICAL CREDIT ASSOCIATION HOLDS ANNUAL MEETING.

Chicago Organization Discusses Trade Problems—H. E. Wilkins Re-elected President.

The twenty-fourth annual meeting of the Electrical Credit Association of Chicago, first set for November, then postponed to December and on account of the coal strike again postponed to February, was held Feb. 10-11 at the La Salle Hotel, Chicago, with about 200 representatives on hand.

In President Wilkins' report for the executive committee he advocated the following measures: Extension of the moral risk club idea in all of the larger cities throughout the central division; establishment of a ledger interchange bureau to connect these centers; appointment of a committee on personnel to inform members on the way to use the E. C. A. service and to secure more complete co-operation; appointment of a committee on a standard accounting system for electrical contractors and dealers, this committee to actively campaign for the adoption of this system among customers of members of the association; change of name of the association so that it will be more clearly expressive of the wide territory covered by the organization, extending as it does from the eastern line of Ohio through the Rocky mountains, and from the Great Lakes to the Gulf of Mexico, and increase of dues to take care of the increase in dues in the national association, the advancing cost of printing the *National Monthly Bulletin* and the *Viewpoint* and the overhead charges of the association.

During the sessions addresses were made by John O. Presbrey, Ivanhoe-Regent Works, Cleveland, on "A Salesman's Viewpoint"; J. P. Davis, Belden Manufacturing Co., Chicago, "Co-ordination Between Purchasing and Credit Departments"; C. E. Vandel, Western Electric Co., Kansas City, Mo., "Municipal Credits"; T. K. Quinn, National Lamp Works, Cleveland, "Lamp Sales and Turnovers"; J. E. Sweeney, Waterloo Electric Supply Co., Waterloo, Ia., "Standard Accounting Methods," and D. E. Crane, Macbeth-Evans Glass Co., Pittsburgh, "Reported Customers."

The annual banquet at the Hotel La Salle Tuesday night, Feb. 10, was attended by about 400 men and women who listened to an address on "Full Steam Ahead" by Theodore G. Soares, professor of theology at the University of Chicago, and a reading by James L. Lardner, professor of oratory at Northwestern university, of Ida G. Tarbell's historic story, "He Knew Lincoln."

The following officers were elected: H. E. Wilkins, Belden Manufacturing Co., president; E. G. Gilmore, Western Electric Co., vice-president; Benjamin P. George, member of Board of Managers, National Electrical Credit Association; E. R. Gilmore and A. O. Kuehmsted, members Executive Committee for 3-year term, and J. H. Taylor, Benjamin Electric Manufacturing Co., Viewpoint representative.

The following territorial chairmen or their alternative reported on E. C. A. activities in their respective districts: F. W. Seywert, Cleveland; W. G. Clarke, Detroit; J. McNamara and T. E. Villmow, Milwaukee; B. F. Smith, Minneapolis; J. Hennes, Sioux City; E. L. Cook, Omaha; W. C. Brady, St. Louis; C. E. Vandel, Kansas City; J. T. Dunnick, Columbus, and T. J. Creaghead, Cincinnati.

USE OF ADEQUATE OUTLETS SUGGESTED BY N. E. L. A.

Electrical Manufacturers Urged to Show in Their Publicity Matter Socket Devices Connected to Baseboard Outlets.

The National Electric Light Association, through its Advertising and Publicity Service Bureau, is drawing to the attention of electrical manufacturers the desirability of their co-operation with other departments of the electrical industry in educating the public to a larger appreciation of the necessity for adequate outlets in homes and offices.

It is believed the time has come for manufacturers of appliances to show their devices connected to baseboard and chair-rail outlets rather than direct to wall or ceiling lighting fixtures. The same is true of manufacturers of wiring devices, fittings, etc., in their publicity, whether it be direct by mail, local or national.

Some manufacturers of wire, who have built their publicity around the idea of the wider use of devices, have found that the emphasis of this point of view has been a potent factor in building good-will for their particular products. The Bureau has sent requests to manufacturers to

keep this subject in mind when preparing printed matter, and suggests that such a course will be of benefit to the industry as a whole.

BRASS MELTING FURNACES DISCUSSED AT PORTLAND.

Joint Meeting of Portland, Ore., Sections of A. I. E. E. and N. E. L. A. Addressed by E. L. Kavanaugh.

The regular monthly meeting of the Portland, Ore., sections of the American Institute of Electrical Engineers and National Electric Light Association, at the University Club, Feb. 10, was attended by many persons, both members and non-members, who were desirous of obtaining information on the operations of electric furnaces as applied to brass melting. On this occasion a paper was read by E. L. Kavanaugh, electrical engineer for the Detroit Electric Furnace Co., who spent some time in Portland supervising the installation of two furnaces of that company's make in the foundry of the Oregon Brass Works.

Mr. Kavanaugh described the various types of furnaces for brass work and outlined the progress made in their development during the last three years. The problems of the war hastened this development to the success of the modern electric furnace. The high expense of electric heat for brass melting was well compensated for by the efficiency of the furnace and the elimination of losses. He went into a description of the Detroit company's indirect arc, rocking furnace, and showed slides and moving pictures of numerous installations in Detroit, Cleveland, Chicago and other cities.

The reading of the paper and the presentation of views were followed by much discussion.

SOCIETY FOR ELECTRICAL DEVELOPMENT TO BROADEN ACTIVITIES.

Greater Support of Society Enables Society to Resume All Pre-war Activities and Expand Its Research and Development Work.

During the war, the Society for Electrical Development was obliged to restrict its activities although it continued throughout to do all its curtailed budget permitted and carried on sufficiently to justify the subscriptions of those members who supported it. During the past three months so many of the big companies have resumed their membership (the General Electric Co., Commonwealth Edison Co., Edison Electric Illuminating Co. of Boston, Consolidated Gas, Electric Light & Power Co. of Baltimore, Middle West Utilities Co., etc.) that the funds available for the society's work are over 50% greater than at the time of the November meeting of the board of directors.

The resumption of membership of the large companies means that the society can extend the scope of its work immeasurably for the benefit of the industry. It has already responded to its increased support by beginning the consideration of several questions that it has been compelled to neglect in the past. The solution of all industry depends at this time upon research and pre-arranged plans. The society is now able to do this work for the electrical industry.

CLEVELAND ELECTRICAL SHOW POSTER CONTEST A SUCCESS.

Excellent Poster Design Secured as Well as Considerable Publicity for the Show.

Chairman P. B. Zimmerman of the Publicity Committee for the Cleveland Electrical Show has announced the winner of the $100 prize offered for the best poster submitted for advertising the coming ten-day electrical exposition which is to open March 10 and close March 20.

Prize-Winning Poster for Cleveland Electrical Show.

The prize was won by Paul Shively, a senior in the Cleveland School of Art, who triumphed over more than 50 rivals for the honor and award.

The contest was a huge success, due largely to the enthusiasm aroused by preparation for the show, which is being managed by the Electrical League of Cleveland, an active organization with over 1000 members.

Several special publicity stunts have been arranged to popularize the show, including an electrical road to the show auditorium, special exhibits in lobbies of banks and other prominently located buildings. The Cleveland Electrical League officials are thoroughly convinced of the value of electrical exhibits and shows to the retail, jobbing, manufacturing and central-station branches of the industry and are encouraging the adoption of the show method of popularizing electrical goods wherever possible. Arrangements have been made to provide the prize-

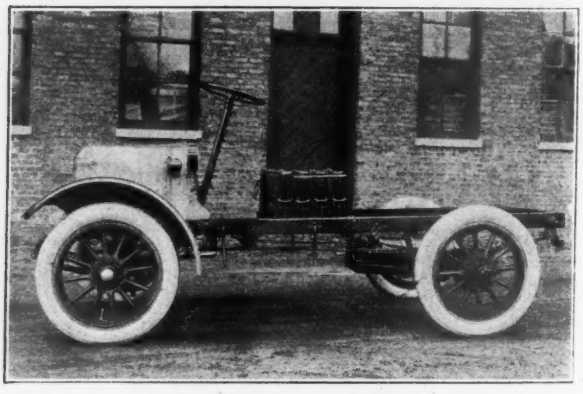
winning show poster for covers of a number of the leading electrical house magazines. Editor F. J. Blaschke has announced the Cleveland poster as the cover of the March number of the *National Mazda Stimulator,* issued by the National Lamp Works.

STEINMETZ ANNOUNCES NEW ELECTRIC VEHICLE.

Low Cost and Regenerative Braking Are Features of Truck Developed After Several Years of Research.

Announcement has just been made by Dr. Charles P. Steinmetz of the commercial development of a new type of light-weight electric truck, the features of which are its low cost of operation and maintenance, reliability and simplicity of operation, the method of motor control, and the design of motor construction and gearing.

The motor is given compound characteristics by means of a storage cell floating on the field circuit. As a result the following advantages are claimed: The speed is well maintained on heavy up-grades and with heavy loads; quick starting; on level and slight down grades the



Steinmetz ½-Ton Electric Delivery Truck, Showing Chassis, Battery Equipment and Power Plant.

maximum speed is limited, so a careless driver cannot race the car; on down grades and in stopping the motor automatically becomes a generator, acts as brake and feeds electric current back into the battery; the brakes are used only for stopping the car, but never on down grades, as the motor checks the speed on down grades and holds it down to a safe limit; much of the power wasted in the motor field at large currents is saved, thus increasing the mileage.

The design of the motor construction and gearing is arranged so that the field and armature of the motor both revolve, each driving one of the truck wheels. The motor acts as differential, with a saving of weight and of power losses in the differential. The motor gives twice as much power as the same motor in the customary arrangement with the field standing still. As the losses in the motor are very little increased, this results in higher efficiency and much less weight than the usual motor, both resulting in a saving of power and corresponding increase of mileage with a given size of battery. A simple and compact power plant is thus obtained.

A saving of weight in the motor, resulting from its double rotation, is obtained, as well as a saving of weight (or increase of mileage) of the battery, due to the recovery of power on the down grades, and due to the lesser weight of motor, etc., which has to be carried.

The Steinmetz Motor Car Co., 512 Fifth avenue, New York City, has been organized to manufacture the new truck. Industrial trucks in three sizes and road trucks in ½-ton and 1-ton sizes will be made, production to start next fall.

CHICAGO TO HAVE TEXTILE PLANT COSTING $5,000,000.

New Industry to Occupy 150 Acres of Land and Employ 10,000 People.

Chicago may become the center of the textile industry of the country in a few years as a result of the recent organization of the Chicago Worsted Mills Co. which is soon to start work on a model plant that will cost $5,000,000 and will eventually give employment to 10,000 people.

Chicago capitalists are behind the project and plans for the buildings are being prepared by Architect Paul Gerhardt, who says the plant will be one of the finest in the country. In connection with the mill, it is proposed to lay out a subdivision and erect modern homes for the workers. The tract will be laid out along the lines of a model city, with boulevards and small parks. Schools, an athletic stadium, theater and public buildings will be built to complete the scheme.

Ground will be broken in the spring for the new plant on a site on the outskirts of Chicago, the exact location of the site being kept secret. Mr. Gerhardt was in the textile business in Austria and Germany for a number of years and made an exhaustive study of the work. He planned and built the big textile mills at Fiume, Austria, at a cost of $25,000,000. In this country Mr. Gerhardt designed and built the first big silk and textile mills at Paterson, N. J., and the blanket mills of the Economy Woolen Co., at Manayunk, Pa.

The establishment of the woolen industry in Chicago will be of interest to the electrical trade as a large part of the machinery used in the textile mills of Massachusetts and other eastern states is electrically operated. In the modern mills to be built in Chicago it is expected that even greater use will be made of electric energy and appliances than in the older mills in the East.

BANKER DISCUSSES PROBLEMS OF TELEPHONE FINANCING.

Suggests Plan of Selling Stock to Consumers on Partial Payment Plan.

A New York City banker, who at one time was the owner of several thousand shares of American Telephone stock, believes that the big problem ahead of the company is its ability to finance its never ending expansion requirements. He believes the time is coming when the company will have to turn to its own customers for capital needs. In this connection he would make it possible for the telephone user, by adding, say,

a dollar a month to his bill, to buy telephone stock on the partial-payment plan. This, in his opinion, would have the double virtue of affording the telephone subscriber the opportunity to secure a sound stock and give the company the advantage of interesting the telephone consumer in the conduct of the business through ownership therein.

CONTRACTORS AND DEALERS OF MASSACHUSETTS HOLD MEETING.

At a recent meeting of the Boston District of the Massachusetts State Association of Electrical Contractors and Dealers, Merrill H. Griffith, of the General Electric Co., explained to the 48 present, representing electrical contractors and dealers, jobbers, manufacturers and the electrical press, the workings of the new postal system of addresses and also extended to all the members an invitation to accompany the Chamber of Commerce on a visit to the Waltham Watch Works.

Frank S. Price gave an interesting talk on the relations of jobber to the contractor and urged that the activities of the organization be made to extend over the entire New England states and suggested that steps be taken to bring about closer co-operation between the central stations and jobbers. This might be accomplished by the appointment of a committee which would confer with a similar committee to bring about better relations.

A. S. Sampson of the Sampson & Allen Co., of Lynn, Mass., explained with the aid of exhibits which he had the details of the new "Access System."

NEW ENGLAND ACCIDENT COUNCIL PLANS FIRST CONVENTION.

In order to secure for its section of the country the inspirational and educational results that have followed each of the National Safety Council congresses, the local councils of Boston, Worcester and Springfield, Mass., are planning to hold the first annual New England Industrial Accident Prevention Congress, March 9-11, at the Bancroft hotel, Worcester, Mass. The Associated Industries of Massachusetts, an organization of 1400 members, will co-operate with the safety councils in making arrangements for the convention.

Speakers of national importance in safety matters will address the convention, including C. W. Price, general manager of the National Council; Charles M. Schwab; R. C. Richards, president of the National Safety Council; R. M. Little, director of the American Institute of Safety; Marcus A. Dow, L. A. DeBlois, C. L. Close, J. W. Powell and Dudley M. Holman, all well known in Safety Council work.

TRANSMISSION LINE TO LINK UP BELGIUM AND ITALY.

Absence of coal in Italy and the high cost of whatever coal is delivered has encouraged the development of Italy's water powers. It is now proposed to link up the coal fields of Belgium to the Italian markets for energy by constructing a high-voltage transmission line between the Belgian coal mines and Lombardy, Italy.

The length of the proposed transmission line will be about 750 miles and the voltage to be employed will be 150,000 volts, three-phase. The power plants located at the mines will utilize powdered coal and use low-grade fuels entirely. It is estimated that the cost per kilowatt-hour transmitted will be 8 centimes as compared with 18 centimes when a kilowatt-hour is produced in Italy with imported coal and taking into consideration only the cost of coal and freight.

NEW YORK ELECTRICAL SOCIETY WILL MEET FEB. 26.

The next meeting of the New York Electrical Society will be held at the United Engineering Societies' building on Feb. 26. Speakers for the meeting will be Robert F. Gowen, engineer for the De Forest Radio Telephone & Telegraph Co. of New York, and Dr. Charles A. Eaton. Mr. Gowen will describe some long distance radio telephone tests, and Dr. Eaton will discuss the electrical side of the great industrial unrest.

COMING CONVENTIONS.

Central Electric Railway Association. Annual meeting, Louisville, Ky., Feb. 26-27. Secretary, A. L. Neereamer, Indianapolis, Ind.

Material Handling Machinery Manufacturers Association. Annual meeting, New York City, Feb. 26-27. Headquarters, Waldorf-Astoria hotel. Zenas W. Carter, secretary, 35 West 39th street, New York City.

American Electrochemical Society. Annual convention, Boston, Mass., April 7-10. Friday, April 9, joint session with American Institute of Electrical Engineers on "Electrically Produced Alloys." Secretary, Joseph W. Richards, Bethlehem, Pa.

American Association of Engineers. Annual convention, St. Louis, Mo., May 10 and 11. Headquarters, Planters Hotel. Secretary, C. E. Drayer, 63 East Adams street, Chicago.

National Electric Light Association. Annual convention, Pasadena, Cal., May 18-21. Headquarters, Hotel Huntington. Acting secretary, S. A. Sewall, 29 West 39th street, New York City.

Ohio Electric Light Association. Annual convention, Cedar Point, Ohio, July 13-16. Secretary D. L. Gaskill, Greenville, Ohio.

National Association of Electrical Contractors and Dealers. Annual convention, Baltimore, Md., Oct. 6. Secretary, W. H. Morton, 110 West 40th street, New York City.

WESTERN ELECTRIC INCREASE.

Stockholders of Western Electric Co. will be asked to vote on a proposal to increase the common stock of the company from 150,000 shares if no par value to 500,000 similar shares, and to authorize $50,000,000 7% cumulative preferred, for the purpose of redeeming present 6% preferred and taking up $18,000,000 floating debt. Only 200,000 shares of new common will be issued soon and stockholders will receive right to subscribe at $180 a share in ratio of 1⅓ shares for each share held.

Commercial Practice

Real Electrical Home Is an Accomplished Fact — Illinois Committee Points Out Value of Public Utility Companies

CENTRAL-STATION MAN PICTURES REAL ELECTRICAL HOME.

Not a Jules Verne Dream but an Accomplished and Demonstrated Fact of Today.

As well known as the use of electricity is, there are still a great many people not familiar with its use in the home, writes H. C. Rice, chief appliance salesman of the Southern California Edison Co., in a recent issue of *Edison Current Topics*. The modern electric home is well lighted by electricity. It is equipped, probably, with the smaller electric devices, such as the iron, toaster, percolator and grill.

But there are many other devices that are not so well known to the household consumers of electric energy. For instance, waffles made on an electric waffle iron start the day right. The electric warming pad, milk warmer and sterilizer keeps peace and health in the nursery; the electric cigar lighter eliminates matches from the den; the electric curling iron and hair dryer saves hair-dresser bills; the piano and phonograph will play for one who merely pushes a button. The sewing machine motor has taken the backache out of sewing and a suction sweeper has put clean into house-cleaning as it removes the germ-laden dust without stirring it up.

Whirring electric fans keep the home cool in summer time and cheerful electric heaters, that heat as the sun heats while burning the new "white coal," warm the home in winter. The electric ozonator keeps the air fresh and sweet at all times.

The kitchen of the modern home has been transformed by the introduction of electricity. The perfect temperature control, the use of stored heat and absence of noxious fumes makes the electric range the ideal cooking appliance for the up-to-date home. In helping to improve the kitchen, the electrical inventor has not forgotten the housewife's dread of dishwashing. By means of the electrical dishwasher the dishes are washed and dried, quickly—and at the same time thoroughly sterilized, a factor that adds greatly to the health of the household and happiness and contentment of the housewife. The electric washing machine does away with washday troubles.

The day of the ice man—like the horse—is fast drawing to a close. Gone forever are the old muddy tracks of the ice man up the front walk, around the house and across the screen porch and kitchen door. Gone are the unsightly, vari-colored cards stuck in the front windows, hung on the fern basket or over the mail box, calling the attention of the world and the ice man that we are in need of ice. From now on the central station will take care of the ice problem. The small refrigerating machines, automatic in every respect, are made to fit into any standard make of family refrigerator, and are capable of maintaining a temperature in the ice box considerably below freezing.

The electrical home as pictured here is not a fantastic dream of a Jules Verne but an actual accomplished fact today in many homes throughout the country.

GROCERY STORES NOT AS IMPORTANT AS PUBLIC UTILITIES.

Illinois Committee on Public Utility Information Sends Out Splendid Suggestions on Subject of Utility Ownership.

Under the title, "A Letter About Your Business," the Illinois Committee on Public Utility Information hands out some pertinent facts addressed to "Mr. and Mrs. Security Holder," in which some very cogent reasons for the support of public utilities are given.

After calling attention to the fact that the attitude of the general public has changed for the better toward public utility companies the little pamphlet points out that the sole reason is that there is a better understanding by the public of the problems of the utilities.

The pamphlet says, in part: "If you owned a grocery store, or any other business, and some person, moved by animus, hope of personal advantage or for any other reason, attempted to injure your property by spreading untruths about it, or even taking steps that might mean confiscation of your property you would immediately seek redress.

Is Grocery More Important?

"Is the grocery store any more important? Any more of a necessity? Any more of a public benefactor? Or more stable in character than the public utility companies, which cannot quit business without wrecking the communities they serve? Whose properties are spiked and cemented or buried in the ground; who every time a new baby is born, must add new equipment to meet the additional demands for light, heat, telephone and transportation service that is to come.

"The time has come for the good citizens, as well as the investor, to ask seriously, if property rights in public utilities are not to be secure, how long will property rights remain secure in the store, the factory, the farm, or even in the home that shelters you?"

The pamphlet urges all citizens to take steps to see that misstatements made about public utili-

ties in which they are interested are not allowed to go unchallenged whether made by individuals or in the newspapers.

Continuing, the pamphlet points out:

"It is unusual to find, in 'The Voice of the People' or 'Letters to the Editor' columns, or even in the news columns, of the daily papers, words of commendation for public utilities, or for that matter, any business. Yet business is the very heart and life-blood of the nation.

"We read of 'Wall street barons,' of 'capital' and of 'labor.' Let's apply the acid test to these terms.

The Real Situation.

"Applying 'Wall street barons' to the real situation: A recent survey in Illinois developed facts (which are paralleled in other states in proportion to population) as follows:

"There are approximately 230,000 direct owners of utility securities who live in the state.

"There are more than 2,000,000 indirect owners, for these securities are held by savings banks and insurance companies, as well as by individuals.

"Of the more than $1,000,000,000 of securities representing the investment of electric light and power, gas, electric street railway and telephone companies of the state, fully 70% are owned within the state.

"The tangible property representing this great investment for public service constitutes public improvements and is as indispensable as water and sewage plants.

"You probably know these facts, but does your neighbor or your daily newspaper know them? When you have seen absolute misstatements of facts in this relation, how many times have you troubled yourself to protect your own business by asking for a correction?

"What does the word 'Capital' mean? Capital is merely the aftermath of 'thrift.' It is the result of 'denial,' for only through 'denial' does the thrifty man accumulate his 'capital.' How many 'capitalists' are there?

"Recent figures show that there are 22,000,000 people in the United States who own $17,852,000,000 worth of Liberty Bonds and War Savings Stamps. The savings of each represent his 'capital.'

How Utilities Are Owned.

"A recent tabulation showed 50,345,000 life insurance policies in force in this country representing $27,189,000,000. Each policy holder is a 'capitalist'—he has created an 'estate.'

"Are these policy holders owners of the public utilities? The figures show that investments of twenty-six life insurance companies in electric railway bonds and stocks alone amount to $116,500,000, and investments in other utilities are even greater. These companies represent 4,000,000 policy holders whose 'estates' are backed by these securities. Each policy holder is thus an owner in those public utility securities. Insurance company officials are hard-headed business men."

Copies of the pamphlet may be obtained in any amount at the rate of $25 per thousand by addressing Illinois Committee on Public Utility Information, 203 South Dearborn street, Chicago.

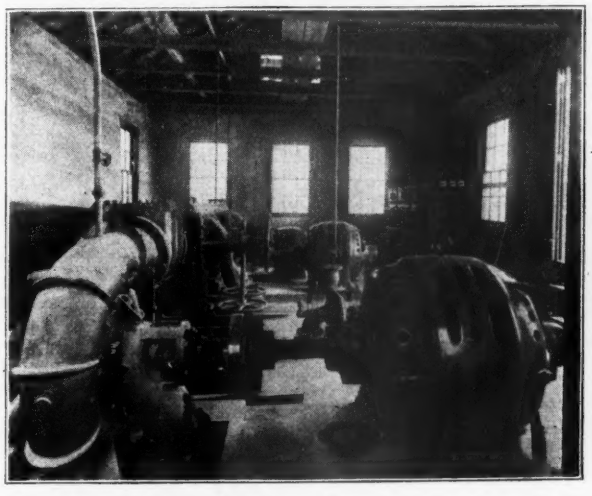
LOW-LIFT ELECTRIC PUMPS FOR IRRIGATION IN IDAHO.

Motor-Driven Centrifugal Pumps Operating Successfully in Several Irrigation Districts Months at a Time.

Many of the irrigation districts, encompassing tracts of valley land along the Snake river, in the neighborhood of Weiser and Payette, Idaho, are supplied with water from that stream by electric pumping. Under this system numerous pumping plants, housed in concrete buildings, have been in operation a number of years and are permanent and constant factors in that country's growth.

The Snake Irrigation District, of Weiser, containing 2600 acres of irrigated land, is typical of the small district that depends upon electric pumping. In the illustration herewith there is shown an interior view of its pump station which has the capacity of 11,000 g.p.m. The four units consist of two 150-hp., 440-volt motors, direct-connected to two 12-in. centrifugal pumps; one 75-hp. motor driving an 8-in. pump, and a 15-hp. motor driving a 6-in. centrifugal. These pumps operate against a head of about 90 ft. and discharge into a 2-mile line of 36-in. wood pipe, the latter leading into open ditches.

This plant has operated four to five months of each season since 1914. The energy is furnished



Electrically Driven, Centrifugal Pumps, Used on Snake River for Irrigation.

by the Idaho Power Co. and the cost of delivering water upon the land amounts to about $4.25 per acre for the season. All this equipment was furnished by Fairbanks, Morse & Co.

The Malheur district, opposite Weiser, on the Oregon side, operates two centrifugal pumps, each direct-connected to a 40-hp. motor, delivering 8000 g.p.m., to irrigate 750 acres, involving low lift. This plant, which contains Fairbanks-Morse pumps and motors, was designed and built by Stuart L. French, consulting engineer, of Weiser.

The Weiser Flat Pipe Line Co., of Weiser, is putting in a new plant to irrigate 500 acres. The equipment, to consist of three centrifugal pumps, to be driven by a 40-hp., 30-hp. and 25-hp. motor, respectively, will be housed in a concrete building and will operate against a head of 60 ft., delivering water into pipe lines.

Power-Plant Practice

Power-Plant Engineering — Insulator Tests — Three and Four-Pass Baffling — Features of Induction Regulators

SOME CONSIDERATIONS INVOLVING SUPPLY OF INDUSTRIAL POWER.

Pertinent Factors Discussed and Their Influence Upon Isolated Plant and Central-Station Supply Shown.

Some very interesting phases of industrial power supply were taken up by Reginald J. S. Pigott, in a paper presented by him before the Worcester Section, A. S. M. E., on the subject

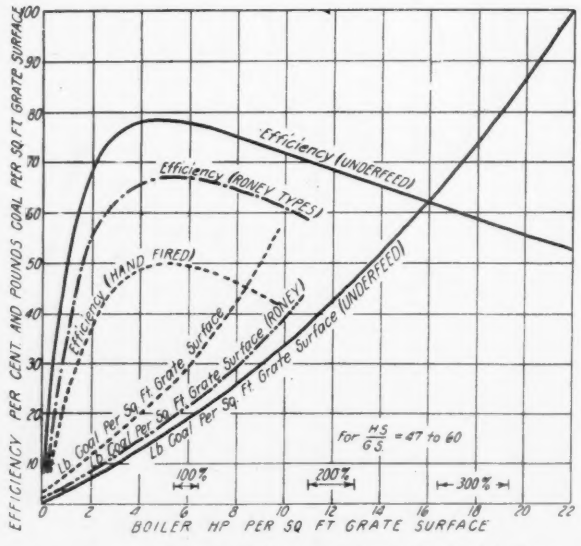

EFFICIENCY PER CENT AND POUNDS COAL PER SQ FT GRATE SURFACE
BOILER HP PER SQ FT GRATE SURFACE
Efficiency (UNDERFEED)
Efficiency (IRONEY TYPES)
Efficiency (HAND FIRED)
Lb Coal Per Sq Ft Grate Surface
Lb Coal Per Sq Ft Grate Surface (IRONEY)
Lb Coal Per Sq Ft Grate Surface (UNDERFEED)
for H.S / G.S = 47 to 60
100%
200%
300%

Fig. 1.—Comparative Efficiency of Underfeed and Overfeed Stokers and Hand Firing at Different Rates of Combustion.

of "Industrial Power." Various phases of industrial power supply were taken up, as centralized power production from central stations, the interconnection of central stations and central-station systems, interconnection of isolated plants among themselves and with central stations.

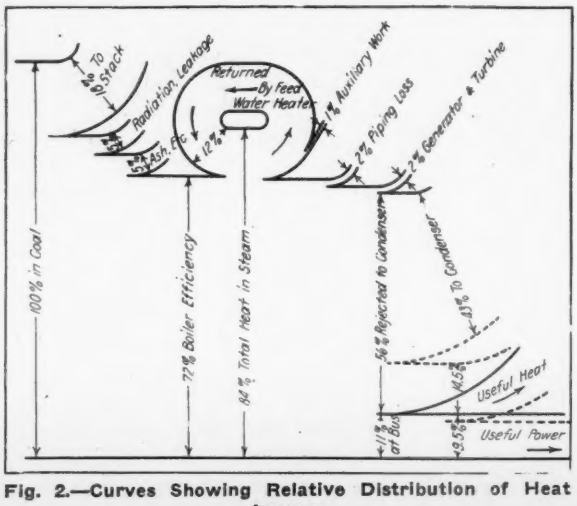


Fig. 2.—Curves Showing Relative Distribution of Heat Losses.

It was pointed out that in reaching a conclusion as to whether an industrial or private power plant is warranted, one of the first conditions to be considered is its size, the second its economy, the third the cost of fuel, and fourthly the question of reliability. Space is often a controlling factor, space sometimes not being available for a private plant, while in many other instances the space is too valuable to be devoted to a power plant. The cost of installation, cost per kilowatt installed, is another factor that favors utility supply in many cases.

The accompanying illustrations are taken from Mr. Pigott's paper. Fig. 1 shows the comparative efficiency of underfeed and overfeed stokers and hand-firing at different rates of combustion. Fig. 2 shows the distribution of heat losses.

LOCATING DEFECTIVE SUSPENSION INSULATORS BY BUZZ STICK.

The buzz stick is the invention of T. F. Johnson and is used by the Georgia Railway & Light Co. for the detection and elimination of defective suspension type insulators. The use of this instrument was fully described in a paper by the inventor presented before the Southeastern Section, N. E. L. A., last September. The buzz stick is used as follows:

Touch the feeling point on the horn AA of the buzz stick to the line conductor and draw it slowly away; there is produced a distinct buzzing sound which continues to be audible, in the case of 110,000 volts, until the feeling point is some 2½ ins. away. Repeat this operation on insulator cap No. 1; the sound is less and follows the feeling point a shorter distance. Do the same with the insulator caps Nos. 2, 3, 4, 5, 6, 7 and 8; it will be found that the sound is less for each cap as the distance from the line increases until on cap No. 6 or 7 there is very little or no sound, and the sound from cap No. 8 is louder than from 6 or 7. These results indicate a perfectly good string.

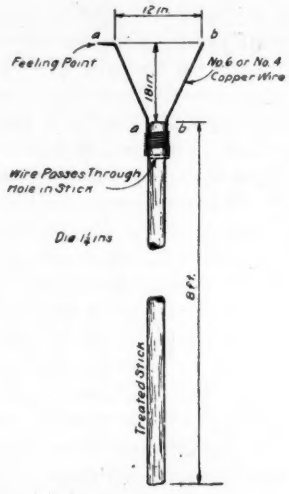
Assuming that insulator No. 2 is totally bad—in other words, dead—in this case the sound from cap No. 1 and No. 2 will be the same and cap No. 6 or 7 will produce a sound. Assuming that insulator No. 6 is bad, then cap No. 5 or 6 will produce the same sound and the sound from cap No. 7 will be very much increased.

Assume that insulators Nos. 2, 3 and 4 are dead, then the sound from caps 1, 2 and 3 will be equal and the sound from caps 4, 5, 6, 7 and 8 will be very much magnified. In other words, the sound from the cap of a dead insulator is the same as the sound from the cap of the next insu-

lator to it, nearest the line. In any of the above assumed cases it would be safe to apply the shorting out process.

Assuming that all insulators are dead except two, applying the shorting out process would knock the line out.

It is a common occurrence on lines that are three or four years old to find strings of insulators which the feeling out operation will indicate as unsafe to apply the shorting out operation. This is especially the case on dead ends.



Johnson Buzz Stick.

In these cases it is advisable to count the whole string as defective, remove it and separate the good insulator units from the defective ones by other tests.

The feeling out operation is for the purpose of determining, without the possibility of flashing or puncturing the string, if there is a sufficient number of good insulator units left in the string to stand the line potential when one of the good insulator units is shorted out during the shorting out process.

On 110,000-volt lines there must be at least three good units to stand the shorting out process; on lower voltages there must be at least two good units, except on voltages such as 11,000 and 13,000 where there are only two insulator units per string, then only one unit need be good.

PERFORMANCE TESTS ON BAFFLES FOR THREE AND FOUR PASSES UNDER WAY.

Salient Features of 15,000-Kw. Turbogenerator Installation of Pacific Gas & Electric Co.

A 15,000-kw. turbogenerator and ancillary equipment was placed in service at Station "A," San Francisco, of the Pacific Gas & Electric Co., last July, bringing the capacity of this station up to a total of 57,000 kw. During the first five months in service this machine operated 3420 hours out of a total of 3672; generator a total of 50,815,000 kw-hrs., or an average of 14,860 kw. The generator has its own air washer.

The condenser is of the Wheeler surface type, contains 25,000 sq. ft. and is served by four two-stage ejectors of the Radojet type, because of the need for conserving space. A recording, integrating and indicating Venturi meter measures the condensate discharged from the condenser and thus gives the water rate of the turbine.

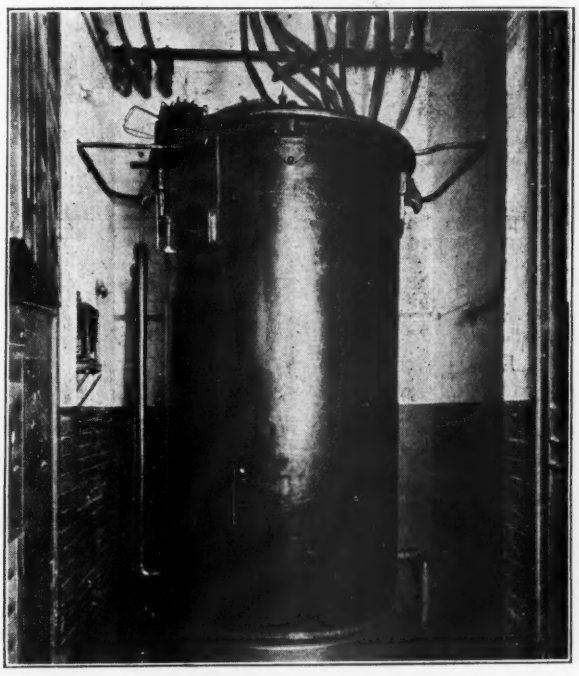
Eight 823-b.hp. water-tube boilers serve the turbine. These boilers are oil-fired, the control of fuel oil being automatic and based upon steam pressure. Four of the boilers have three passes and four four passes. The four-pass units are the more efficient, but because of the difference in cost of maintenance, performance data to determine the comparative cost of maintaining three and four baffles are being collected to determine which form of baffling proves ultimately the most desirable. The eight boilers are set high, to permit of using coal either on stokers or pulverized if necessary in the future, are set in four batteries of two each, with a 157-ft. steel stack, 8 ft. in diameter, for every two boilers. Each boiler is equipped with a Bailey instrument for recording steam flow, air flow and stack temperature and a differential draft gage.

FEATURES OF 500-KW., 11,000-VOLT INDUCTION REGULATOR.

Mobility, Isolation and Accessibility Salient Details of Installation.

The Hartford Electric Light Co. is employing a 500-kw., three-phase, 60-cycle, induction regulator for controlling the voltage on one of its 11,000-volt feeders. This regulator is oil cooled and is of quite large proportions, as shown in the accompanying illustration.

The regulator is inclosed in a cell and mounted



Hartford Electric Light Co.'s 500-Kw., 11,000-Volt Induction Regulator.

upon a steel carriage which rides on wheels resting upon a track. In this way the regulator may be easily moved in and out of its cell, if desired. The cell is sufficiently wide to permit a man to climb in behind the regulator for cleaning purposes. The thermometer for indicating oil temperatures, the motor controlling relay, etc., are accessible for inspection and maintenance.

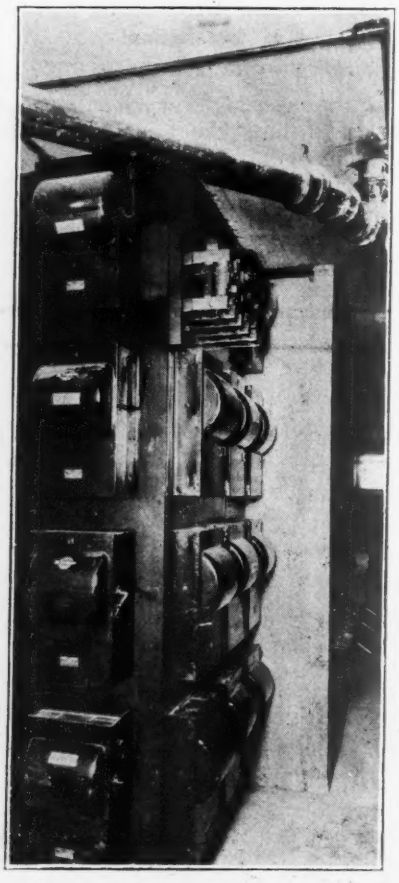
Contracting-Construction

Use of Safety Switches on Switchboards — Revision of the Safety Code and of the National Electrical Code

PRESENT TENDENCIES IN SAFE CONSTRUCTION OF SWITCHBOARDS.

Protection of Nonelectrical Employes Requires Safe Construction—Opportunity for Contractors in Installation Work.

Owing to the increasing labor shortage which necessitates the employment by industrial plants of men and women having no electrical experience, the question of protecting the "green employe" from electrical hazards is of paramount importance. Industrial companies, cognizant of this new responsibility created not only by a realization of the humanitarian aspects of the problem but by the tremendous expense entailed by accidents, are rapidly reconstructing their electrical equipment in such a manner that the element of danger is reduced to a minimum. Exposed portions of current-carrying parts are being protected so as to insure safety to life, reduction of fire hazards and simplicity of operation.



Fourteen Safety Switches Mounted on Steel Panelboard in Sperry Flour Co. Plant at Spokane.

Dead-front switchboards have already found a broad range of application, as they protect the inexperienced operator by providing a centralized control for starting motors and miscellaneous power circuits. They also make a better installation from the electrical standpoint.

The accompanying illustration shows 14 modern type safety switches mounted on steel panelboards in the Sperry Flour Co. plant at Spokane, Wash. The safety switches used were made by the Square D Co., Detroit, Mich., and control 2300, 440, 220 and 110-volt circuits.

Such a board has a great many advantages. It can be constructed by any responsible electrical contractor; as the material used consists chiefly of pipe or angle irons, pipe clamps, conduit, steel plates used for panels and the safety switches themselves. An unusual feature is its flexibility. Switches that are already individually installed on motors are easily convertible to a central power panel and panels already mounted can easily be changed for individual drives.

REVISION OF PART III OF SAFETY CODE.

As announced in previous issues of the ELECTRICAL REVIEW, the National Electrical Safety Code issued by the Bureau of Standards is now undergoing revision at the hands of that organization. A preliminary draft of the proposed changes in Part III of this Code was issued on Aug. 15, 1918, in the form of photolithographed leaflets that were sent for criticism to a large number of interested persons and organizations in the electrical industry. Numerous suggestions and comments have been received since that time and based on these, further changes have been made which have recently been issued by the Bureau as a leaflet. Unless additional pertinent changes are offered in the immediate future, Part III will appear as now revised in the forthcoming new edition of the Code.

Part III of the National Electrical Safety Code comprises rules for the installation of utilization equipment, that is, rules for interior wiring (except in generating stations and substations which are covered in Part I) to insure such construction as will minimize the electrical life and accident hazards in service. The additional changes now suggested include: Elimination of grounding for short lengths of conduit or raceways used for protecting wires; new clearances near exposed live parts; new rule on electrical protection of conductors; identification of grounded and neutral conductors; requiring disconnection of fuses before handling; requiring dead-front switchboards where accessible; rules for elevator wiring.

Proposed Changes in the National Electrical Code—I.

Principal Recommendations for Revisions Made in Reports by Standing Committees of the Electrical Committee, N. F. P. A.

According to long established custom, the National Electrical Code has been revised every two years to keep it abreast of developments in electrical construction practice. The 1918 edition of the Code will therefore be revised this year and, as announced in our last issue, a public hearing to discuss proposed changes will be held in New York City on March 23 and 24 at the call of the Electrical Committee, National Fire Protection Association, which is the final authority on the changes recommended to the National Board of Fire Underwriters that issues the National Electrical Code.

Numerous subcommittees of the Electrical Committee have for practically a year considered the need for changes suggested from various sources and eleven of them have submitted reports with recommendations that the Electrical Committee has published as a large-size 27-page bulletin. In the following the principal changes recommended are given in the same order as in the bulletin; that is, as reported by the various standing or special subcommittees, but in most cases condensed to the actual major recommendations.

To indicate the exact nature of new matter introduced in the proposed changes of the rules, the new words in revised rules and the entire wording of new rules are printed in bold-faced type.

Committee on Cars and Railways.

This committee had referred to it the study of Rule 40 (car wiring) and Rule 41 (car-house wiring), but took no action on the former because it felt that the present Rule 40 was satisfactory to all concerned except where high voltages were employed and in these relatively few cases special rules can readily be made.

It was recommended that Rule 41 be quite completely revised as follows:

41. Car Houses.

(a) Trolley Wires.

The trolley wires must be securely supported on **suitable** insulating hangers, **designed for voltage used, and must be placed at such a distance apart that the distance between any two hangers is less than the distance from the trolley wire to the floor or rail.**

Wood troughing or sufficient protection to prevent trolley pole forming a contact with any metal part of building shall be provided.

(b) Cutout Switch and Line Breakers.

Must have an emergency cutout switch **in an accessible location** outside of the building, so that all trolley wires in the building may be cut out at one point. Line insulators must be installed, so that when emergency switch is open, the trolley wire **leading into the building** will be dead at all points **preferably** within **50 ft.** of the building. **In car houses not used as operating stations,** the current must be cut out of the building when not needed for use in the building.

If the feed to the car house is underground, the emergency switch may be installed inside the building, but must be located at a point as near as practicable to where the underground feeder enters the building.

When car house or yard is divided into fire sections, auxiliary cutout switches shall be arranged to control each section independently and may be located outside of building near track entrance.

Trolley wires in car-storage yards, or distinctive sections of a large storage yard, shall be controlled by an emergency cutout switch as described above. Yards in conjunction with car houses shall be treated as a separate section and have auxiliary cutout switch.

(c) Approved lightning arresters shall be installed to adequately protect all overhead trolley wires in car houses and car-storage yards inside of the line insulators (breakers).

(d) Current collectors shall be removed from contact with trolley wire while cars are not in use. Suitable signs, posted in conspicuous places, are recommended.

(e) Must have all rails bonded at each joint with a conductor having a carrying capacity at least equivalent to No. O. B. & S. gage annealed copper wire, and all rails must be connected to the outside ground return circuit by a not less than No. O. B. & S. gage copper wire, or by equivalent bonding through the track.

(f) Power third rails shall be rigidly supported on suitable insulating supports and properly bonded at joints.

Power rails within each fire section of building or storage yard shall be controlled by an emergency cutout switch located in a readily accessible place outside of building.

(g) Except as **hereinafter** provided in Section **h,** all wiring and apparatus **shall be** installed in accordance with **approved practice** for constant-potential systems.

(h) All lamps and stationary motors must be installed in such a way that one main switch may control the whole of each installation, lighting and power, independently of the main cutout switch called for in Section b.

When current for lighting, stationary motors, **heating, testing apparatus, etc.,** is from a grounded trolley circuit, the following special rules to apply:

(1) Voltage from light, heat or power shall not exceed 750 volts.

(2) Approved cutouts and switches must be placed **in the** nongrounded side of lights and motors they are to protect. **Light circuits must not exceed** 2000 watts dependent upon a single cutout.

(3) Drops to lights shall be flexible rubber-covered wire or packing house cable.

(4) In series systems sockets shall be of the keyless type and of a voltage rating for the current used.

(5) Electric heaters to be of standard type.

(6) The main ground, or return wire, shall connect with the rails or negative feeder at not less than two places, and shall be protected against mechanical injury.

(7) All cutouts and switches **in grounded systems should be installed in cabinets of nonconducting material. Wooden cabinets shall be lined with ¼-in. fire-resisting insulating material and painted with a nonconducting paint.**

(8) All light and power wiring where subject to mechanical injury shall be installed in metal conduit.

(i) All portable testing, lighting and power devices

shall be constructed of standard materials, and to withstand hard usage. All pendent cords and portable conductors will be considered as subject to hard usage.

(j) **Controlling devices and apparatus for feeder distributing systems for outside distribution must be installed in a fire-resisting room or compartment.**

COMMITTEE ON DEVICES AND MATERIALS.

Outlet Boxes.—Regarding the use of covers on outlet boxes, it was recommended that Rule 27*b*, paragraph 1, be changed as follows:

Must be equipped at every outlet with an approved outlet box or plate, as required in conduit work, **the box or plate to be completely covered by an approved cover or fixture canopy.**

It was also recommended that Rule 28*d*, par. 1, first sentence, be changed to read:

Must be equipped at every outlet with an approved outlet box or plate, **the box or plate to be completely covered by an approved cover or fixture canopy.**

Cabinets and Cutout Boxes.—The Subcommittee on Cabinets and Cutout Boxes recommended addition to Rule 19 (Switches, Cutouts, Circuit-Breakers, etc.) of a new section, as follows:

f. All unused outlet openings in cabinets and cutout boxes, junction and outlet boxes, metal molding, conduit, etc., must be effectively closed by metal which will afford protection substantially equivalent to that of the walls of the cabinets, etc.

In Rule 59 (Outlet, Junction and Flush Switch Boxes) change Section *c*, first par., to read:

c. Must be so made that all openings not in use **may** be effectively closed, etc.

In Rule 70 (Cabinets and Cutout Boxes) add to Section *c* the following new paragraph:

Must be so made that all openings not in use may be effectively closed by metal which will afford protection substantially equivalent to that of the walls of the cabinet or cutout box.

In the same Rule 70, change Section *d-2* as follows:

There must be an air space of at least 1-in. between any **live metal part (including live metal parts of enclosed fuses)** and the door, unless the door is lined with an approved insulating material when the air space must be not less than ½ in.

Rubber-Covered Wires and Cables.—The Subcommittee on Wires and Cables recommends changes of part of the table in the second paragraph of Rule 50 *b* with the idea of requiring greater thickness of rubber insulation for 1500, 2500 and 3500-volt cables. These increases in thickness are recommended by the Committee on Wires of the A. I. E. E. and bring about uniformity of insulation thickness for various types of rubber insulation in common use on a-c. circuits. The changes in the table are as follows:

	Thickness in 64ths of an inch		
	R-15	R-25	R-35
Size of Conductor	1500 volts	2500 volts	3500 volts
14 to 8	6	8	10
7 to 2	7	9	10
1 to 4/0	8	10	10
225,000 to 500,000 CM	9	10	11
525,000 to 1,000,000 CM	10	10	12
Over 1,000,000 CM	10	10	12

Interests concerned have agreed upon a standard for the stranding of wires in building up stranded conductors for wires and cables for use in electrical circuits, through which material economies in stocks of individual wires will be effected. Allowable carrying capacities of the conductor sizes secured under this program to appear as a new section of Rule 18 are recommended as follows:

Strands No. Mils	Size of Strand	Cir. Mils	Table A Rubber Insulation Amperes	Table B Other Insulation Amperes	Outside Diameter Inches over Copper
7/25	22	4,490	15	20	.075
7/32	20	7,150	20	25	.096
7/40	18	11,370	25	35	.120
7/51	16	18,080	35	50	.153
7/64	14	28,740	50	70	.192
7/81	12	45,710	70	90	.243
7/91	11	58,000	80	110	.273
7/102	10	72,680	90	130	.306
19/64	14	78,030	100	150	.320
19/72	13	98,380	125	175	.360
19/81	12	124,900	150	210	.405
19/91	11	157,300	175	250	.455
19/107	*	217,500	225	325	.540
19/114	9	248,700	250	350	.570
37/91	11	306,400	275	400	.637
37/97	*	347,500	300	450	.679
37/102	10	381,200	325	500	.714
37/116	*	484,300	400	600	.798
61/102	10	633,300	475	700	.918
61/107	*	698,000	500	750	.963
61/114	9	788,500	550	825	1.030
61/121	*	893,100	600	900	1.090
61/128	8	1,007,000	650	1,000	1.150
91/114	9	1,191,000	725	1,125	1.250
91/128	8	1,502,000	850	1,350	1.410
127/114	9	1,660,000	900	1,460	1.480
127/128	8	2,097,000	1,100	1,700	1.660

***These individual strands are odd sizes not listed in the American or B. & S. Wire Tables.**

Varnished Cloth Cable.—The subcommittee on these cables recommends their recognition as suitable for use either in open wiring or in raceways where not exposed to moisture. Slight changes are recommended in Rules 26*g* and 26*i* to include such cables. A new (third) paragraph is to be added to 26*n*, as follows:

Varnished-cloth insulation may be used in permanently dry locations.

In Rule 18 a new column is to be added to the table and designated "Table C—Varnished-Cloth Insulation," as follows:

Size	Amperes	Size	Amperes
18	....	400,000 CM	390
16	....	500,000 CM	480
14	18	600,000 CM	540
12	25	700,000 CM	600
10	30	800,000 CM	660
8	40	900,000 CM	720
6	60	1,000,000 CM	780
5	65	1,100,000 CM	830
4	85	1,200,000 CM	880
3	95	1,300,000 CM	920
2	110	1,400,000 CM	970
1	120	1,500,000 CM	1,020
0	150	1,600,000 CM	1,070
00	180	1,700,000 CM	1,120
000	210	1,800,000 CM	1,160
200,000 CM	240	1,900,000 CM	1,210
0000	270	2,000,000 CM	1,260
300,000 CM	330		

It is recommended that the present text of Rule 53 be abandoned and No. 53 assigned to a new rule as follows:

VARNISHED CLOTH INSULATED WIRE.

Type Letter VC.

(For installation rules see No. 26g, i and n.)

This insulation may be used where not exposed to moisture.

a. The insulation must consist of layers of varnished cotton cloth applied and filled as specified,

and must have coverings as specified for Rubber-Covered Wire. (See No. 50c.)

b. **The thickness of the insulation shall not be less than for the rubber insulation of rubber-covered wire of the same conductor size. (See No. 50b.)**

c. **Must comply with requirements of No. 49b as to identification tags, etc.**

d. **No individual conductor, whether solid or stranded, shall be less than No. 14 B. & S. gage in nominal size; the use of varnished-cloth insulation is not recommended under ordinary conditions in conductor sizes smaller than No. 6 B. & S. gage. Conductors may be either plain or tinned.**

e. **Tests. The following tests are specified:**

(a) **On the wire as a whole; voltage test, insulation resistance test.**

(b) **On test specimens; heating test, dielectric strength.**

Fuses.—Committee considered several matters. As to inclosed fuses, it recommended change in Rule 68*c* that in effect will make renewable fuses of approved type fully standard according to the Code. The new wording of the second paragraph of No. 68*c* is to be as follows:

For nonrenewable fuses the fusible wire must be attached to the terminals in such a way as to make it difficult for it to be replaced when melted.

COMMITTEE ON FIXTURES, HEATERS, SIGNS AND LAMPS.

Fixtures.—The Subcommittee on Fixtures and Insulating Joints recommended amendment of Rule 35*a* by eliminating the first sentence, and transfer of the second sentence to Rule 23*d*. It also recommended to amend Rule 35*b* to read:

Must not be used in show windows or in other locations where inflammable material is liable to come in contact with **lamps or shades unless installed in approved fixtures equipped with shades or guards, suitably ventilated to prevent dangerous rise in temperature.**

Amend 35*c*, first sentence, to read: 250 watts instead of 200. Omit second sentence of 35*c*.

Amend 30*a*, fourth paragraph, to read:

Insulating joints and canopy insulators may be omitted in the following cases:

1. **Straight electric fixtures which are metallically connected in a permanent and effective manner to metal conduit, armored cable or metal raceway systems or to gas piping, provided, such gas piping is grounded in the manner prescribed for conduit in No. 15A.**

2. Straight electric fixtures connected to knob and tube, wooden raceways or open work, except on metal ceilings or on plaster walls or ceilings containing metal lathing.

3. Straight electric fixtures which are permanently and effectively grounded to a separate ground wire not smaller than No. 14 B & S gage.

4. Combination fixtures in which all wires have an approved rubber insulation not less than three sixty-fourths inch in thickness and where gas piping is grounded, as in item 1 above.

Amend Rule 77*a* by adding a new paragraph to read as follows:

Fixture studs which are not a part of the outlet box, hickeys, tripods and crowfeet, must be of malleable iron or other approved material.

Condense Rule 77*b*, second paragraph, to read as follows:

On chains or similar parts where conductors are not completely enclosed in metal, the conductors must be stranded and must, when externally wired, be so secured as not to be cut or abraded by the pressure of the fastenings or motion of the fixture, and be protected against abrasion where they pass through sheet-metal pans, canopies, etc.

Amend 32*d*, second paragraph, by adding the following:

Except that for portable lamps or other devices which are not liable to be moved about sufficiently to cause abrasion of the insulation, approved flexible cord (type letter C) may be used.

Heaters.—The Subcommittee on Heaters recommended that Rule 25 be completely revised as follows:

25. **Heating Appliances.**

(a) **General:**

1. Each **complete heating appliance whether containing one or more heating elements and which is** of more than six amperes or 600 watts **total** capacity must be protected by a cutout. **Heating appliances** of six amperes or 660 watts capacity, or less, may be grouped under the protection of a single set of fuses, provided the rated capacity of the fuses does not exceed ten amperes, or may be connected individually to lighting circuits when the normal load in use on the circuit at any time will not exceed 600 watts.

2. Each **complete heating appliance** of more than six amperes or 660 watts capacity and each group **of appliances** not exceeding six amperes or 660 watts capacity must, **except as provided in Section b-2 of this rule,** be controlled by a switch plainly indicating "on" and "off," located within sight of the **appliance** and arranged to cut off all **of the wires** from the **appliance.**

The single-pole switches on the individual units of electric ranges, etc., are not to be considered as taking the place of the switch required by this rule.

3. Must each be provided with a nameplate, giving the maker's name and the normal capacity in volts and amperes, or in volts and watts.

(b) **Portable Heating Appliances.**

1. Flexible conductors for smoothing irons and sadirons, and for all devices requiring over 250 watts, must have an approved insulation and covering complying with the requirements of No. 51 i.

2. With portable heating appliances, approved plug connectors must be used, so arranged that the plug may be pulled out to open the circuit without leaving any live parts so exposed as to render likely accidental contact therewith. The connector may be located at either end of the flexible conductor or inserted in the conductor itself.

An approved attachment plug and receptacle of not over 30 amperes rating may be employed in lieu of the switch required in Section a-2 of this rule.

3. Smoothing irons, sadirons and other heating devices that are intended to be applied to combustible articles must be provided with **approved** stands.

It is strongly recommended that each such heating device or group of devices be used with approved signal or with an approved protective device.

(c) **Stationary Heating Appliances:**

1. Stationary **heating appliances,** such as radiators, ranges, plate warmers, etc., must be so located as to furnish ample protection between the device and surrounding combustible material.

2. The supply conductors to stationary heating appliances (which are obviously intended by size, weight, and service to be secured in a fixed position) should preferably be in conduit. In case this is impractical the exposed conductors must be so located as to be protected from mechanical injury and moisture.

Supply conductors must be of rubber-covered wire up to the terminals of the appliance, except where they are subject outside of the terminal box to a temperature in excess of 120 deg. F. (49 deg. C.) in which case wires having heat-resisting covering must be used.

3. The metal frames of all stationary **heating appliances must be permanently and effectively grounded** as provided in No. 15A.

To admit of three-wire supply to electrical heating appliances it was recommended that Rule 23*d*, fourth paragraph, be amended to read:

All branches or taps from any three-wire system which are directly connected to lamp sockets must be run as two-wire circuits and all wires of all branches or tap circuits which are directly connected to lamp sockets or other translating devices must be protected by proper fuses.

(*To be continued.*)

New Appliances

Water-Heater Works Instantaneously—New Wire Splice Insulator—Sarco Steam Trap Shows New Expansion Feature

Improved Electric Water-Heater Is Instantaneous.

The Aqua Electric Heater Co. of New York City, is marketing an improved electric water-heater that is meeting with much success. The heater is a small piece of apparatus that is attached to a faucet and heats water instantaneously as it is drawn from the tap. The heater is applicable to the demands of the bathroom, barber shop, hospital, office, soda fountain, home, hospital and

Water Heater Is Wired as Permanent Fixture, Direct to Meter.

other places in which hot water is wanted, and can be supplied to accommodate any voltage, although ordinary stock is constructed for 110 or 220 volts. The beater weighs 16 lbs.

The characteristic feature of this device consists of a cylindrical body of porcelain in which are 22 tubular passages, from top to bottom. These passages are connected progressively to each other by porcelain caps, so that the 22 passages become one continuous passage.

The water to be heated enters into the passage from the house piping and continues in circuit through the 22 passages, from the last of which it is led to the discharge faucet. The passages are all provided with non-corrosive coils, distributed in series in circuit, and terminals of this heating element are connected by means of a snap switch to the source of current supply. Therefore, when the water flows through the porcelain passages it passes directly over the heating element.

The faucet is connected with the current supply switch, so that when the handle is in an upright position all action is shut off. By turning the handle to the right, the water and current are simultaneously turned on, producing hot water. By turning the handle to its upright position the current and water are simultaneously cut off. Turning the handle to the left allows the cold water to by-pass the porcelain passages directly to the outlet. Increase of water temperature can be obtained by decreasing the flow, to a point of boiling if desired.

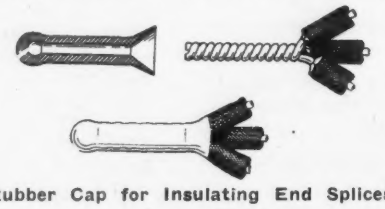
The current is, of course, consumed only when the water is flowing through the tap and the cost is based on the consumption of 6.6 kw. per hour when operating continuously at a temperature of 65 deg. F. That is, at a cost of 2 cts. per kw.-hr., 90 gals. may be had at 110 degs. F. for 12½ cts. per hour. At 3 cts. per kw-hr., 70 gals. may be had at 132 degs. F. for 18 cts. per hour; at 4 cts. per kw.-hr., 36 gals. at 195 degs. may be had at 25 cts. per hour and at 5 cts. per kw.-hr., 30 gals. may be had at 205 deg. for 30 cts. per hour.

New Wire Splice Insulator.

The Elasticap Co., Hoboken, N. J., has introduced a new splice insulator of new Code rubber called the Elasticap. The Elasticap is a rubber tube closed at one end and wide at the other so that it slips over the wire splice easily and completely. Elasticaps have been tested and approved by the Underwriters' Laboratories, Inc., and are listed as standard in its list of inspected electrical appliances.

The insulator covers smoothly the rough surfaces of the soldered splices, such as are found in fixtures, and at outlets of house wiring installations, where Nos. 14, 16, and 18 wires are spliced together in any two-wire or three-wire combination. This applies equally to end splices in junction boxes and metal molding fittings where saving of space is so desirable and important.

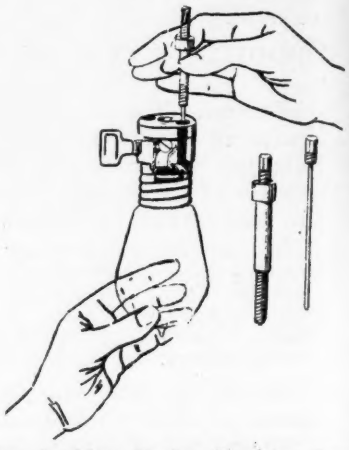
It is claimed that the time saved by the use of this small appliance is a large item in itself, as compared with the expenditure of time and labor in applying the average grade of rubber tape to end splices. Any one with experience along this line will no doubt be reminded that such tape is often stretched to perilous thinness to make it cover the splice tip, resulting in perforated insulation, exposed ends and grounded and short circuits. These defective conditions it is claimed are done away with, as the thickness of the insulating walls is in excess of the Code regulations.



Rubber Cap for Insulating End Splices.

Lamp-Locking Device Is Concealed by Socket Cap.

The L. M. T. Lamp Saving Device Co., 276 Wilbraham Road, Springfield, Mass., has introduced a new locking device, attachable to any electric light socket. The device consists of a small metal pin with a triangular head, which screws through the porcelain base, being threaded into a hollow screw which fastens the socket onto the porcelain. It is claimed that this safety device positively prevents lamp stealing, as it is next to impossible to remove the pin without a special tool. The pin does not project above the porcelain base and therefore cannot be removed by a pair of pliers or similar tools, and the entire device is concealed by the socket cap when it is in place.



Lamp Locking Device Requires Special Tool for Removing Lamp.

Test Stand for Locating Ford Starting Troubles.

With a new test stand now marketed, all starting and lighting system troubles of Ford automobiles may be located and repaired under conditions identical with those in the actual use of the car.

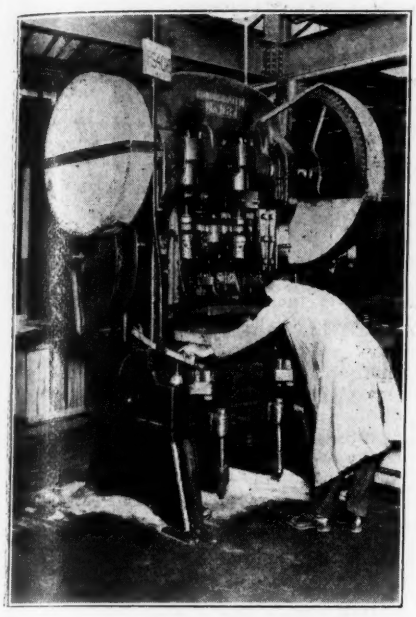
The "cutting in speed" is shown and also the "regulation" and "high speed." The third brush location can be properly made only with this equipment, it is claimed. Motoring speed and current draw of the generator is shown, as well as the torque and running speed of the motor. Any shorts or grounds are easily located with the telltale and test points.

Every provision is made for the proper testing and repairing of the generator and motor.

The F-B test stand is exclusively distributed by the Fairbanks Co., Broome and Lafayette streets, New York City.

Effective Safety Device Used on Side Press Machines.

The accompanying illustration shows a motor-operated side press in use in the machine shop of the Square D Co., Detroit, Mich., which is provided with an effective safety device for protecting the hands of the operator. The press



Automatic Safety Lever on a Side Press in Use in Square D Co.'s Plant.

is actuated by a tread or lever which throws the clutch. Without the safety device, the operator, while operating the press with his right hand, may unconsciously fail to remove his left hand from the metal he has placed on the die and thus lose his fingers or perhaps his entire hand when the press closes. To prevent this inadvertency a lever is provided also for the left hand. This is connected in the rear of the press to the right-hand lever by means of a rod. Both levers, right and left handed, must be held down at once to throw the clutch. To press but one only raises the opposite lever and allows the clutch to slip. Thus the operator is compelled to keep both hands out of danger in order to operate the press.

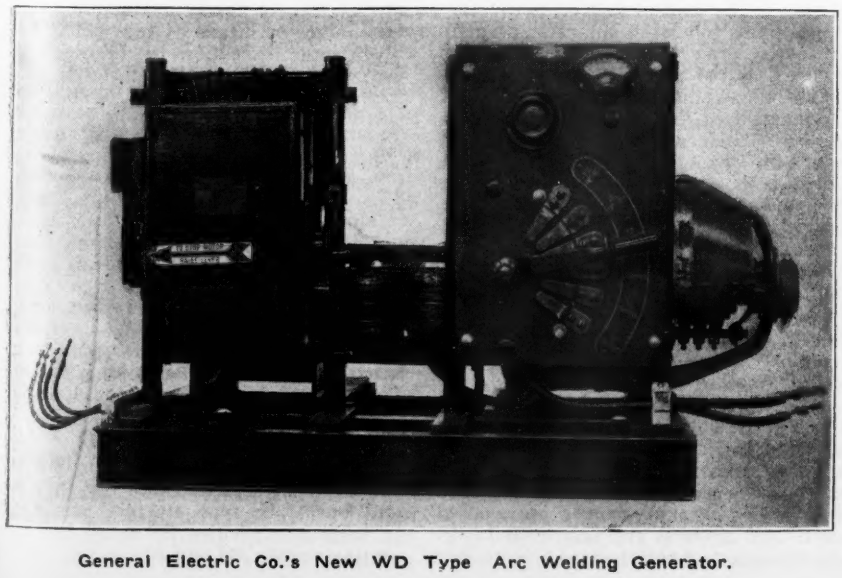
Curiously, this side press stamps, presses, perforates and fashions sheet-steel into boxes which are used to inclose the live parts of electric switches —a protective device for household and industrial users of electric current. The switch is also shown in the illustration.

General Electric Develops New Arc Welder.

There has been a very marked activity during the past year in equipment for arc welding work, and the General Electric Co. has developed a new generator known as the WD type, which can be either belt-driven or direct-connected to gas engines or other power available. A large number have been ordered.

These generators are especially designed to obtain in one machine all the characteristics demanded by arc welding service. This is obtained without the use of external ballast resistance or separate excitation from any external source. Neither a separate circuit nor direct-connected exciter is used. Since the machine provides its own excitation, the voltage characteristic is such that throughout the proper working range of the arc the energy delivered is practically constant. The voltage and current follow the momentary variations in the arc conditions practically instantaneously and consequently the lag between change in arc conditions and resulting corrective change in electrical conditions is reduced to a minimum. This lag is one cause of trouble in welding with self-regulating welding equipments, whether the automatic feature is embodied in the revolving apparatus or mounted on the panel.

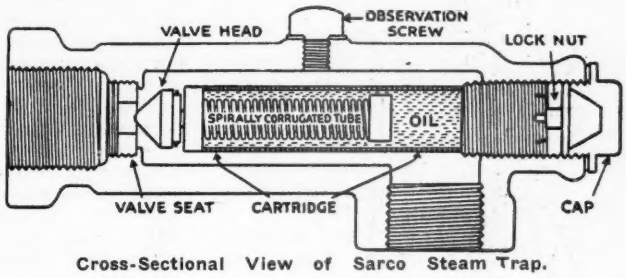
The generator is so wound as to give a no-load or striking voltage of 60 which, when the arc is struck automatically, decreases to the voltage required by the arc. This voltage is from 18 to 20 for the average operator and average good work. A longer arc is undesirable, since poor work is liable to result. Skilled operators on smooth work are sometimes able to hold a very short arc with a voltage as low as 16, but in rating the generator the value of 20 is used. By adjustment of the dial switch on the panel, the current may be adjusted from a maximum of 200 to a minimum of 75 in 25-ampere stops. The approximate current values are plainly marked at the different steps on the dial switch.



General Electric Co.'s New WD Type Arc Welding Generator.

Hydraulic Expansion Feature of Sarco Steam Trap.

The Sarco steam trap, marketed by the Sarco Co., Inc., Woolworth Building, New York, differs from other types of steam trap in that it utilizes the pressure of a fluid (a heavy hydrocarbon oil) hermetically sealed within a tube. A section of the trap is shown herewith, and is seen to consist of a steam-pipe body, which can be screwed on anywhere in a steam main, as it occupies very little space and takes the place of an elbow or bend. In this body a Sarco cartridge is inserted, this cartridge containing an easily expansible fluid operating a corrugated, hermatically sealed tombac tube. To the lower end of this tube is attached a piston which carries the valve head.



Cross-Sectional View of Sarco Steam Trap.

The trap requires simply to be put into position and the cartridge unscrewed a few turns. When the steam has heated up the cartridge, expanding the fluid and forcing out the piston, the cartridge is to be gently screwed forward, until the valve head meets the seat, closing up the steam. The adjustment can then be locked and the trap works automatically. As soon as water collects, the fluid contracts and the valve opens. The condensation is then ejected by the pressure behind it, and immediately the steam comes into contact with the cartridge there is an expansion and the trap closes. Thus, whenever condensation is in the line, the valve is open but no live steam ever gets past. The action is unvarying, as the oil never fatigues.

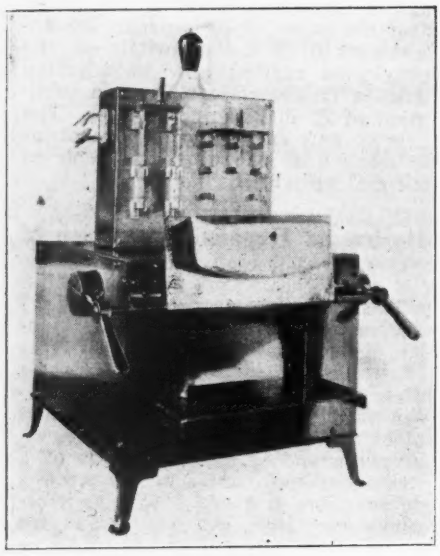
The use of liquid (hydraulic) expansion permits the use of this trap not only for low pressure but also for high pressures up to 200 lbs. It needs no storage space, as required by the bucket or float traps it displaces; it is far cheaper and is the smallest, lightest, and most compact trap on the market.

Muffle Type Electric Furnace.

The General Electric Co. has developed an electric furnace of the muffle type, which is designed to meet

the demand for a durable, economical and convenient furnace for temperatures up to 850 deg. C., for baking vitreous enamel, hardening and tempering tools, dies, etc.

The device consists of the furnace proper with a control panel mounted on



Muffle Type Heat Treating Furnace.

top, at the front. The furnace is very strongly built, but small enough to be placed anywhere that will prove convenient. The heating element, which is mounted on the outside of the muffle and covered with compound, is so placed as to give a very even distribution of heat throughout the inside. The element is divided so that it is possible to get two degrees of heat, for convenience called high and low heat. The former is used to give a high initial heat so that the maximum temperature can be reached quickly—and the latter maintains the given temperature. The furnace is mounted in a strong steel casing, and the walls, door, etc., are thoroughly insulated, thus preventing loss of heat from radiation.

The control panel, which carries the necessary apparatus for controlling the furnace, is equipped with a main line switch, a double-throw switch for high or low heat, and a red pilot lamp which acts as a warning to the operator when the furnace is on high heat. There are connections at the side of the panel for connecting rheostats when temperatures as low as 300 deg. C. are desired. By this arrangement, a very good control of the temperature is assured, and, due to the pilot lamp, there is very little excuse for the destruction of material due to carelessness, or inability on the part of the operator to tell what the heat is.

The furnace is further provided with a shelf in front for the convenience of the operator, and the door is equipped with counterweights to keep it open. The high heat necessitates 4 kw. to bring it up to 850 deg., and the ordinary running temperature only takes 1.8 kw.

The advantages of such a furnace for laboratory or shop use are manifold. The fumes, noise, and smoke that accompany the usual furnace are absent, and so is the necessity for a number of pipes to carry gas to the furnace. It is claimed that the fire risk of the furnace is practically non-existant. It is perfectly safe to go away and leave it absolutely alone for any length of time, on low heat, and the pilot lamp serves as a warning so that the high heat will not be left on. It does not occupy a great deal of space, and can be set in the most convenient place for operation, without disturbing any of the rest of the installation.

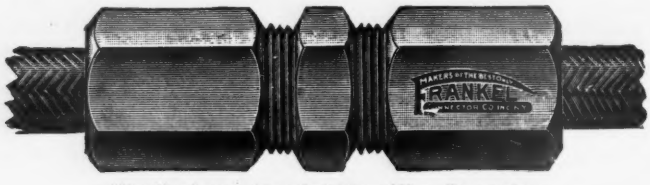
Solderless Connectors Combine Efficiency with Economy.

Affording a perfectly efficient splice of wire or cable that will stand maximum overload without injury, the Westinghouse-Frankel solderless connectors represent a new method of splicing which combines reliable service with marked economy. They are simple in design, strong and are easily installed. They are made in various styles and sizes for adaption to all types of splices with all varieties of wire.

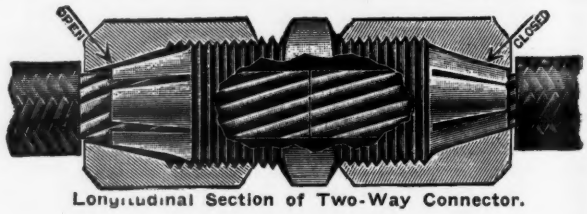
In making use of a two-way connector, the insulation is removed from the ends of the cable or wire to be spliced for a distance equal to half the length of the connector. The bared ends are then inserted into the connector so that they meet at the center, after which the compression nuts are tightened. These nuts are so constructed that they force inward a set of jaws at each end of the connector, causing them to grip their respective conductors firmly, forming a perfect joint. Splices with the other styles are made in the same manner as with the two-way type.

These devices are furnished with a plain finish unless otherwise specified. They can be had, however, with finishes of the following colors at a small advance in price: Nickel, copper, bronze, copper oxidized and satin bronze.

The new solderless connector has been approved by the National Board of Fire Underwriters. In a burn-out test with No. 1 stranded cable in which both a soldered lug and a solderless connector were included in the circuit, the solder in the lug melted and caused the connection to give way, while the solderless connector withstood the test without serious injury.



Westinghouse-Frankel Two-Way Connector.

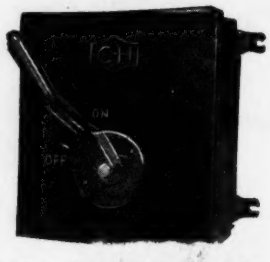


Longitudinal Section of Two-Way Connector.

New Safety Starter for Direct-Current Service.

The Cutler-Hammer Manufacturing Co., of Milwaukee, Wis., has made an addition to its line of inclosed starters, the new starter being shown in the accompanying illustrations. The inclosed feature removes all danger of exposed parts and protects the button and segment contacts from damage due to fine collecting dust or spraying water. This starter, known as Bulletin 2111, is very desirable for small direct-current motors in exposed locations, driving lineshafts, fans, blowers, pumps, drills, and small motor-generator sets for arc welding.

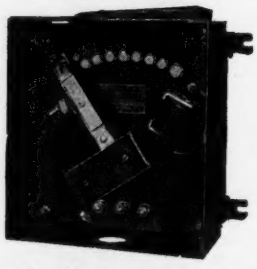
It consists of the familiar type of d-c. hand starter inclosed in a sheet-metal case, having an external lever which engages the movable arm of the starter. The external, or operating,



New C-H Inclosed Motor Starter, Which Has No Exposed Live Parts.

lever is insulated from the revolving contact arm by a block of molded insulation. A pointer on the lever and legends stamped on the cover indicate to the workman whether the starter is "off" or "on." A low-voltage release coil in series with the shunt field protects the motor in case of voltage failure or if the field should be opened while the motor is running. The armature resistor is completely inclosed in the starter case, which is kept well ventilated by a flue in the top. Renewable contacts are provided on all starters, except the smallest, which also has a black insulating composition knob in place of the ordinary operating lever. The inclosing case is arranged for the enlar to the latest design open-face type of C-H standard starter, which can be changed to the inclosed starter described above in the few minutes required to trance of conduit from the under side. The starter is easily mounted on any flat surface by means of four bolts.

With the exception of the inclosed feature, the Bulletin 2111 starter is simi-



Starter with Cover Removed, Showing Contacts, Contact Arm and Low-Voltage Release Coil.

change the operating lever and put on the inclosing case. Both the inclosed and open-face type starters are made in various capacities up to 50 hp., operating at 115, 230 and 500 volts.

Trade Activities

Sanford Riley Stoker Co. Sends Out Interesting Bulletin—Anderson Co. Changes Name — Remmert Co. Rebuilding

Sanford Riley Stoker Co., Worcester, Mass., is sending out the second edition of its bulletin on Sanford Riley stokers. This brochure is of 48 reading pages, and is devoted to the construction and installation details of these underfeed stokers. Each part of the stoker is taken up in detail, its purpose, its construction and operation being explained. Special emphasis is placed upon the more prominent features of this type of stoker, namely, the reciprocating retort sides, the large live grate surface, self-cleaning features, the safety connecting rod of each individual retort and the continuous ash discharge. On pages 25 to 34 engineering data of a very valuable nature are compiled, dealing with furnace chambers, settings for different types of boilers and fuels. Dimension sheets for the Sanford Riley stoker are then given, after which the combustion of fuel and the evaporation of water are taken up. The last five pages are devoted entirely to illustrations of typical power plants, although line drawings and halftones are employed very generously throughout the text. The brochure is an interesting one, full of instructive matter to every power-plant designer and operator. A copy may be obtained free of cost by interested parties on writing the company.

Northwestern Electric Co., 408-416 Hoyne avenue, Chicago, has sent out folders showing the workings of the new Martin alternating current to direct current rotary converter and the Variable Speed single-phase motor for use in connection with printing machinery. Particular stress is laid on the value of the Martin converter for use in battery charging and for projecting real "sunlit" moving pictures. Martin rotary converters are designed to operate on 110, 220 or 440 volt, 25, 30 or 60 cycle, a-c lines delivering 70 to 80 volts d-c to the arc lamps and are in demand for furnishing direct current to moving picture arcs in a-c districts. The machine, according to claims made for it by the manufacturer, has all the reliable features of a motor-generator set, combined with high efficiency and durability. The Variable Speed motor is a simple series compensated motor combining high-starting torque, low-starting current, with high efficiency. It can be used on 25 or 60 cycle circuits without change. It is wound for 110 volts only, the different line voltages being cared for by the A. K. variable controller. Owing to this controller the load of the motor rarely reaches 85 volts, and through never being overloaded is assured of a long life.

Jordan Brothers, Inc., New York City, manufacturer of the Jordan Commutator Truing Device, has sent out an interesting booklet dealing with the success of its device during the 22 years it has been on the market. The Jordan device will true commutators without removing the armature from generator or motor and is made in a number of sizes and types so as to be suitable to the largest type units as well as the smaller sizes, both belted and direct-connected. The device consists of a grinding-wheel in ball bearings, and equipped with appropriate clamps whereby it can be fastened to the rocker arm or motor frame. It operates as follows: The truing device is fastened in position so that its shaft is parallel to the generator or motor shaft, and the grinding-wheel just clears the commutator. A round belt passes around a driving pulley on the grinding-wheel shaft and from there to a grooved pulley on a 1-hp. motor. The grinding-wheel is movable parallel to the commutator, and has sufficient range so that it can be fed across the entire length of the commutator face. The wheel used is of a special composition and contains no emery or other mineral matter which can injure the insulation between commutator segments.

Remmert Manufacturing Co., Belleville, Ill., is already at work rebuilding its factory building, completely destroyed by fire on Jan. 27 last, and will commence operation in its new building with new equipment and twice its former capacity within the next 60 days. Temporary manufacturing facilities have already been obtained and production already resumed. The Remmert Co. manufactures the Locomotive electric clothes washer. At the time of the fire the daily production was the largest in the history of the company. More than 500 completed machines were ready for shipment on rush orders. While the loss is covered by insurance, the company regrets the delay that will ensue in the shipments to dealers.

Cutler-Hammer Manufacturing Co., Milwaukee, Wis., has issued a small folder describing C-H electric space heaters in which the space heater is referred to as "Two Feet of Electrical Heat." This standardized steel-jacketed heater meets, so the company claims, the demand for innumerable heating purposes and is especially applicable in places where otherwise it would be hard to obtain heat. The heater consists of a ribbon of nichrome steel resistor incased in sheet mica and mounted on a steel strip. A steel jacket is placed over the resistor and mica and then sealed in a hydraulic press. Two insulated eyelets in the steel strip permit easy mounting and two binding posts with nuts and washers provide for connecting to any light or power current of proper voltage. Each heater has a capacity of 500 watts and may be connected to any a-c or d-c lighting or power circuit of 115, 230 or 250 volts pressure. Being made up in 500 watt capacity, the heaters provide a very flexible scheme of heating. In appearance the heater is flat like an ordinary ruler, the thickness being only 3-16 in. The other dimensions are 1½ in. by 24 in. It is built to withstand hard service and vibration, as all parts are enclosed and cannot jar loose. There is no porcelain, cement, asbestos or molded insulation material employed. In connection with the heater the company is carrying on a comprehensive advertising campaign.

Anderson Electric & Equipment Co., 118-124 South Clinton street, Chicago, announces that the stockholders have authorized the change in name of the company from the **Anderson Electric Specialty Co.,** to the name given above. There is no change either in the officers or in the company's organization, the change being made solely to render the corporate name more descriptive of the character of the products manufactured by the company and to eliminate the word "specialty," which did not properly describe the Anderson lines, which are staple articles known and sold throughout the world.

Cutler-Hammer Manufacturing Co., Milwaukee, Wis., held its annual meeting of the sales force of the switch and specialty department during the week of Feb. 9, last. The work of the past 12 months was briefly reviewed, followed by a general discussion of all the switches. sockets and wiring appliances in the C-H line. Among the interesting features mentioned was the widespread use of C-H 70-50 switches, which have been extensively advertised through trade publications and national magazines.

Carrick Engineering Co., Chicago, the inventor and manufacturer of the Carrick combustion control, is sending out their bulletin entitled "Carrick Combustion Control." This ten-page brochure discusses the manner in which the Carrick system automatically correlates fuel and air supply by individual control of stoker engine or motors, dampers, forced or induced draft blowers. The basic principles upon which the Carrick system operates, the results obtained, and a few of the satisfied users are some of the subjects taken up.

Blaw-Knox Co., Pittsburgh, Pa., has purchased the C. D. Pruden Co. of Baltimore, Md., manufacturer of standardized steel buildings for industrial plants, warehouses, cottages and garages. The Pruden company will retain its old name.

Current News

News of Construction Activities and Business Opportunities

EASTERN STATES.

Skowhegan, Me.—A dam and power plant is being erected by the Central Maine Power Co. Sufficient ledge has has been blasted from the bed of the river for the construction of the foundation for the first two units of the plant and at the same the tail race which will carry the water away from the immense turbine water wheels is being formed by this excavation. Eventually five wheels will be installed, each of which will develop 4300 hp.

Windham, Me.—E. I. duPont de Nemours Co., Wilmington, Del., will rebuild its Windham plant, recently destroyed by fire with loss estimated at $200,000. It is planned to build a power plant for electric operation of the new works.

Springfield, Mass.—Cheney Bigelow Wire works has awarded a contract to L. S. Wood, 14 Stockbridge street, for the erection of the proposed new one and 2-story brick addition to its plant at Warwick and Heywood streets. The structure will be about 45 by 450 ft.; and is estimated to cost $100,000.

Springfield, Mass. — Westinghouse Electric & Manufacturing Co. has completed plans for the construction of a large new machine shop to be located in the East Springfield district. The structure will be 1-story, concrete and steel, and is estimated to cost about $400,000, including machinery and equipment installation. Bernard Prack, Keystone building, Pittsburgh, is architect for the company.

Derby, Conn.—Derby Gas Light Co. is making rapid progress on the construction of the new 2-story brick, concrete and steel boiler plant addition to its works, about 40 by 100 ft., contract for which was recently awarded to M. A. Durschmidt, Derby.

Hartford, Conn.—Hartford Electric Light Co. has awarded a contract to the Stone & Webster Engineering corporation, Boston, Mass., for the construction of a new power station to be located in the south meadows district. The proposed new station will comprise two units of brick, concrete and steel, the initial unit to be 3-story, about 200 ft. in length.

New Haven, Conn.—Acme Wire company, 973 Dixwell avenue, manufacturer of electro magnets, magnet wire, etc., has filed notice with the Secretary of State of an increase in its capital from $1,500,000 to $3,000,000, to provide for general business expansion.

Binghamton, N. Y.—State Hospital Commission, Albany, E. S. Elwood, secretary, has taken bids for the proposed rewiring of the main building at the Binghamton State hospital, to provide improved service.

Buffalo, N. Y.—South Buffalo Terminals, Inc., is having plans drawn for a 1-story industrial building, 230 by 2200 ft., to be erected at Colgate and Reading streets and the South Buffalo Industrial railroad. The initial unit will be 800 ft. in length and will cost $250,000.

New York, N. Y.—Mica Insulator Co., 68 Church street, manufacturer of insulation specialties, etc., is having plans prepared for the erection of a new 3-story reinforced concrete addition to its plant at Schenectady, N. Y., for increased operations. The proposed new structure is estimated to cost about $150,000. W. L. Stoddard, 9 East 40th street, is architect for the company.

New York, N. Y.—Board of Trustees of Bellevue & Allied Hospitals, 415 East 23d street, has had plans prepared for the construction of a new boiler plant at the Fordham hospital, Crotona avenue and Southern boulevard, for increased power facilities.

New York, N. Y.—New York Telephone Co. has had plans prepared for the construction of a new 5-story telephone exchange plant on 30th street, near Second avenue, extending through the block to the south side of 31st street. The structure will be about 112 by 180 feet, and is estimated to cost close to $1,000,000.

New York, N. Y.—Edwards & Co., Exterior avenue and 145th street, manufacturer of electrical products, etc., is considering plans for the construction of a new 2-story addition to its plant, brick and concrete type. The proposed structure will be about 61 by 95 ft.

New York, N. Y.—Wireless telephone conversation between New York and London in near future at rate of 24 cents a minute is predicted by Marconi.

Ogdensburg, N. Y.—Cooper Brass Works, Inc., is having plans drawn for a new plant to cost about $100,000.

Rochester, N. Y.—Josiah Anstice Co., 220 North Water street, is making rapid progress on the construction of the new 1-story power plant and boiler house at its plant on Humboldt street, between Culver road and Coventry avenue. The structure will be about 50 by 100 ft.

Rome, N. Y.—Rome Wire Co. has awarded a contract to the John W. Cowper Co., Inc., Fidelity building, Buffalo, for the remodeling of the Carrick plant in Clyde avenue, near Kensington avenue, formerly devoted to the production of shells for the Government, recently acquired by the company. The plans also include the construction of two new additions to the plant, about 100 by 280 ft., and 120 by 240 ft., estimated to cost about $250,000, as well as the erection of an administration building. The company proposes to utilize the works for the production of insulated wire.

Watertown, N. Y.—Beebbe Island Syndicate is understood to be having preliminary plans prepared for the construction of a large new hydro-electric station on Beebbe Island, near Watertown, of brick, steel, and reinforced concrete construction. The proposed new development is estimated to cost close to $1,000,000. J. G. White & Company, Inc., 43 Exchange place, New York, is engineer.

Bayonne, N. J.—Preliminary steps are being taken by local business interests for the installation of a white way type electric street-lighting system throughout the lower section of Broadway.

Dover, N. J.—New Jersey Power & Light Co. is making rapid progress on the construction of a new 33,000-volt transmission line to the Dickerson mine of the Replogle Steel Co., for general works operation. The company has recently completed the construction of its 33,000-volt power line to Newton, N. J.

Dover, N. J.—Dover Boiler works has recently awarded a contract to the New Jersey Power & Light Co. for furnishing additional electric energy in the amount of 400 hp. for the operation of its plant.

East Orange, N. J.—City Council is arranging plans for the installation of a new electric street-lighting system throughout Main street and Central avenue.

Jersey City, N. J.—Philippine Vegetable Oil Co., foot of 12th street, has had plans prepared for the construction of a 1-story reinforced concrete power plant, estimated to cost $12,000, exclusive of equipment. The company is also having plans prepared for the construction of a total of about seven new steel tanks, estimated to cost $60,000.

Newark, N. J.—C. R. Curtis, formerly connected with the Splitdorf Electrical Co., has perfected the organization of a company to manufacture electric equipment and accessories for automobiles, and has awarded a contract to the American Concrete Steel Co., 27 Clinton street, Newark, for a plant to be erected at Warren and Hackett streets, Newark. The first unit will be eight stories, L shaped, 60 by 172 ft., of reinforced concrete, and with equipment is estimated to cost $500,000. It is expected to have the building ready for occupancy in June. A second unit will be about 56 by 160 ft., and will

be followed by other buildings until the entire site, 192 by 370 ft., is occupied.

Oldwick, N. J.—Borough Council is considering plans for the installation of a new electric street-lighting system throughout the municipality. A lighting commission will be elected at an early date.

Plainfield, N. J.—American Motors Co. is having plans prepared for a 2-story brick addition 165 by 300 ft., to cost $200,000, including equipment.

Readington, N. J.—Readington Township Committee is considering plans for the installation of a new electric street-lighting system in the Three Bridges district. It is understood that the proposed plans include the establishment of an electric plant in the Rockefeller mills property, near Three Bridges.

Trenton, N. J.—Considerable electrical and mechanical equipment will be required in connection with the construction of the proposed new plant of the Blabely Laundry Co., 11 South Warren street. The structure will be 1-story, about 85 by 180 ft.; located at Brunswick avenue and North Montgomery avenue, and is estimated to cost about $100,000. Contract for erection has been awarded to N. A. K. Bugbee Co., 206 East Hanover street. R. B. Blabely heads the company.

Wilmington, Del.—Seaboard Rolling Mills plan to change the mill from a blooming mill to a rolling mill during the next three months. A new gas house will be constructed at a cost of $55,000 for the purpose of furnishing gas for the company's furnaces. Two new electric cranes will be installed.

Chester, Pa.—Chester Crystal Ice Co. has awarded a contract to the W. F. Koelle Co., 26th and Oxford streets, Philadelphia, for the construction of the proposed new 1-story ice manufacturing plant at Chester. The structure will be about 88 by 130 ft., and will have a capacity of 60 tons; it is estimated to cost about $200,000, including equipment installation.

Gettysburg, Pa.—Borough has voted $20,000 in bonds for establishment of a municipal lighting plant. Address borough clerk.

Philadelphia, Pa.—Charles E. Dearnley has had plans prepared for the construction of a new 1-story brick and concrete power plant and engine house, about 36 by 90 ft., to be located at Bayton street and Chelten avenue.

Philadelphia, Pa.—The plant to be erected by the Belmont Packing & Rubber Co., 133 North 2nd street, at Janney and Butler streets, will be 2-stories and basement, 120 by 130 ft., and will cost about $100,000 with equipment.

Philadelphia, Pa.—Franklin Electric Co., 3111 North 15th street, is arranging for the opening of new headquarters at 15 North 7th street. The company's new establishment will be under the management of William T. Walker, recently general manager of the Frank H. Stewart Electric Co., 37 North 7th street, and Samuel Bordman, formerly sales manager of the Stewart company. It is proposed to carry a complete line of electrical equipment and supplies, with inauguration of operations by March 1.

Pottstown, Pa.—Sotter Brothers, Inc., manufacturer of steam boilers, stacks, tanks, etc., has had plans prepared for the immediate construction of a new addition to its plant, to provide for increased capacity. The structure will be 1-story, about 95 by 120 ft., and is estimated to cost $100,000, including machinery and equipment installation. Contract for erection has been awarded to the McClintic-Marshall company, Pittsburgh. H. M. Lessig is president.

Scranton, Pa.—A. O. Dewitt Auto Co. is having plans prepared for a 2-story service and repair plant, 90 by 170 ft., to cost $100,000, including equipment.

Baltimore, Md.—Southern Electric Co. has completed negotiations for the purchase of the Sexton building, 7 South Gay street.

Baltimore, Md.—Universal Electric Furnace Co., 1520 Fidelity building, has been organized with $150,000 capital stock to manufacture electric brass-melting furnaces. Raymond M. Glacken is vice-president of the company.

Elkton, Md.—Havre de Grace Electric Co. has completed negotiations for the acquirement of the plant of the Perryville Electric Co. The new owners are planning to continue the operation of the plant for increased facilities.

Frederick, Md.—Plans are under consideration by the Farmers' Association for the establishment of a new local hydroelectric plant for local business service. William J. Grove, president of the M. J. Grove Lime Co., is interested in the project.

Hagerstown, Md.—Street Commissioners are arranging for the issuance of bonds for $300,000, the proceeds to be used to cover the cost of the construction of a new electric light plant to be located on Antietam creek.

Westport, Md.—Chesapeake Iron Co. is taking bids for a 1-story shop addition 58 by 210 ft., to cost $50,000.

Bridgewater, Va.—North River Electric Co. is considering plans for the installation of a new three-phase generating unit, the construction of an auxiliary steam plant, and extensions in its transmission line to extend to Mount Crawford, about 2½ miles. G. Richard Berlin is president and manager.

Fredericksburg, Va.—Rappahannock Electric Light & Power Co. is having plans prepared for the installation of considerable new equipment in its plant, to provide for increased operations. The proposed work will include the rebuilding of the company's distribution system. S. C. Foster is general superintendent.

Massne, Va.—The city will erect a municipal lighting plant, two stories high, at an estimated cost of $60,000.

Charleston, W. Va.—In connection with the construction of the new plant of the Virginia Rubber Co., estimated to cost about $200,000, considerable electrical and mechanical equipment will be required. The proposed plant will include the erection of a new power house for general factory operation.

Charleston, W. Va.—Virginia Rubber Co., Union Trust building, has commenced the construction of a 2-story and basement plant, 118 by 180 ft., for the manufacture of automobile tires. With power plant for works service, the new plant will cost about $100,000. E. T. Baird is president.

Mount Hope, W. Va.—Plans have been prepared by the Mount Hope Electric Power & Water Co. for extensions in its transmission system, to provide for increased operations. George A. Waldo is president and manager.

Sistersville, W. Va.—Cranes, boiler-shop equipment and other machinery will be installed by the Sistersville Tank & Boiler Works at its new plant, to cost about $30,000. Charles Helfrich is manager.

Warrenton, W. Va.—Warrenton Electric Light & Power Co. is arranging plans for increased operations at its local plant. The work includes the construction of a new transmission line, about five miles in length, and the installation of new equipment at its plant, comprising generator unit, boiler equipment, etc. M. J. O'Connell is secretary and manager.

Weston, W. Va.—Weston Electric Light, Power & Water Co. is having plans prepared for extensions in its plant and system to cost about $50,000. The work includes the remodeling of the present plant building and improvements in the distribution system, as well as extensions in the waterworks plant of the company. Contract for the work has been let to the Fairmont Electric Service Co., Fairmont, W. Va. Dan A. Maurer is consulting engineer.

Asheville, N. C.—Carolina-Tennessee Power Co. has completed arrangements for the new hydroelectric development on the Hiawassee River in North Carolina and Tennessee. In connection with the work, the plans include the erection of two 150-foot dams, one to be located near the Tennessee state border, and the other 13 miles further up the river in North Carolina. The plans provide for the development of a total of about 60,000 hp. ultimately, and the project is estimated to cost in excess of $9,000,000. W. V. N. Powelson, 61 Broadway, New York City, is consulting engineer for the company.

Benson, N. C.—City has authorized a bond issue for $50,000, the proceeds to be used for the construction of a new municipal electric-light plant. L. Gilbert is city clerk.

Burlington, N. C.—Piedmont Power & Light Co. is having plans prepared for the construction of a total of four miles of new transmission line, for increased operations. It is also proposed to install a quantity of new equipment in its plant. Julius H. Hardin is vice-president and general manager.

Greenville, N. C. — City Council

Water & Light Commission, is considering plans for the installation of new equipment in the municipal electric plant, for increased capacity, including turbine condenser, etc. F. A. Haskins is acting superintendent.

Estill, S. C. — Commissioners of Public Works, James Howe, chairman, are having plans prepared for the construction of a new 1-story brick electric light plant, about 35 by 50 ft. to be used for municipal service.

Lyerly, Ga. — City will install an electric street-lighting system, power to be furnished by the Chattanooga River Power Co. Address Mayor, Lyerly, Ga.

Smithville, Ga. — City is contemplating installing an electric-lighting system. Address Mayor, Smithville, Ga.

Safety Harbor, Fla.—City is negotiating with the Clearwater Lighting Co., Clearwater, Fla., in reference to bringing electric current to Safety Harbor. City also planning to establish electric-lighting system. Address C. S. Washington, mayor.

NORTH CENTRAL STATES.

Alliance, O.—Under a new contract signed with the city the Alliance Gas & Power Co. will need about $45,000 of new lamps and equipment before Sept. 1, 1920. Under the new contract 529 city lamps will be operated and any of the present poles, wires, or other equipment that is not in good shape, will be replaced.

Dayton, O.—Dayton Light & Power Co. has closed a contract for a 25,000-kv-a. General Electric Co. turbine for installation at its Miller's Ford station. This will give the station a capacity of approximately 60,000 kw.

Dayton, O. — Burnett-Larsch Co., manufacturer of electric pumping machinery, is planning the construction of a 5-story, reinforced concrete and brick addition, 60 by 180 ft., to cost about $150,000.

Lebanon, O.—City Board of Trustees is having plans prepared by Chase & Wright, engineers, Union Central building, Cincinnati, for a 1-story municipal light and power plant to cost about $120,000, including equipment.

Sandusky, O.—Ajax Motor Co. will establish a large plant in Sandusky, the estimated cost of which will be $1,250,000. The first unit will be in operation within a year and will give employment to 1500 people.

Sandusky, O. — Brown Clutch Co. will enlarge its plant by the erection of one building, 30 by 64 ft., and another, 100 by 128 ft., doubling its present capacity. The new buildings will be equipped with 5-ton travelling cranes, molding machines and air compressors.

Elwood, Ind. — Pittsburg Plate Glass Co. will expend $100,000 for new factory buildings.

Evansville, Ind. — Schmadel Packing Co. will erect a new building, 100 by 100 ft. to cost $60,000.

Muncie, Ind. — Big Four Railroad company will award contract March 1 for a 2-story reinforced concrete freight house, to cost $150,000.

Shelbyville, Ind.—The Kennedy Car Liner & Bag Co. will build an addition to its plant, 60 by 257 ft., to cost $25,000.

Carmi, Ill.—City will vote on Feb. 25 on the question of issuing $15,000 in bonds for the purchase of a new engine for the electric light plant. Address city clerk.

Chicago, Ill.—Commonwealth Edison Co. is having plans prepared for a new electric generating plant at Calumet, Ill., to cost in excess of $750,000, including equipment.

Chicago, Ill.—Reliable Electric Co., 411 South Sangamon street, will erect a 1-story plant to cost $85,000 on Carroll avenue, east of Kedzie street.

Elgin, Ill.—Elgin National Watch Co., is having plans prepared by Postle & Fisher, Chicago, for several 4-story buildings to be erected at the Elgin plant, at an estimated cost of $1,000,000.

El Paso, Ill.—The El Paso Telephone Co. plans to rebuild its line this season. Most of the cable will be installed underground.

Evanston, Ill.—Davis hotel, to cost $1,800,000, will be erected by Henry T. Davis.

Pullman, Ill.—Pullman Co. is constructing a new 3-story plant with 300,000 sq. ft. of floor space and a press building, 80 by 200 ft. It is also remodelling its foundry buildings to furnish 190,000 sq. ft. of additional space. The improvements are to take care of the manufacture of automobile bodies, and with equipment will cost about $3,500,000.

Rock Island, Ill. — Rock Island Register Co. will build a $75,000 plant.

Rock Island, Ill. — Rock Island Manufacturing Co. is building a foundry addition, 80 by 120 ft., to cost $25,000.

Detroit, Mich. — American Electrical Heater Co., Woodward and Burroughs avenues, manufacturer of electrical heating devices, will build two 1-story additions, 60 by 417 ft., and 23 by 32 ft. The larger building will be used for general manufacturing and boiler plant service and the smaller for assembling work.

Midland, Mich.—H. P. Co. manufacturer of mechanical products, is considering the erection of a 1-story machine shop, 60 by 150 ft., to cost $50,000. Carl C. House is manager.

Davenport, Ia. — Nelson Manufacturing Co., of St. Louis, Mo., will erect a 4-story reinforced concrete warehouse, 96 by 140 ft., to cost $175,000.

Dubuque, Ia.—An election will be held to vote on the question of purchasing or erecting an electric light and power plant to be operated by the municipality. Address John Stuber, city clerk.

Washington, Ia.—Iowa Gas & Electric Co. plans many improvements during the year owing to the large increase in business in towns surrounding Washington and the growing demand for new rural lines. The company will add a new 1500 kw. steam turbine with a capacity of 2200 hp. within the next few months. The improvements will cost $50,000 and will include the construction of 50 miles of rural line. Homer Darbyshire is manager.

Jefferson City, Mo. — The Kansas City Railways Co., Kansas City, Mo., has made application to the Missouri Public Service Commission for an increase in rates which have been fixed by the Commission for electrical current furnished to the Kansas City Light and Power Co. The company lost $324,096 on this service in 1918, and $256,345 for the first eleven months of 1919.

Kansas City, Mo.—Plans are being prepared for the erection of a $1,750,000 railroad station, for use by various interurban companies operating in the vicinity of Kansas City.

Topeka, Kan.—Trefrey Motor Co. plans to construct a 5-story garage, 75 by 100 ft., to cost $100,000.

Omaha, Neb. — A special election will be held to vote on the question of issuing $2,000,000 in bonds for erecting and completing electric light plant. Address city commissioners.

Eagle Butte, S. D.—Local business men have organized a company for the building of an electric light plant for the city. The plant will be operated on a 24-hour service basis.

Gregory, S. D.—A special election will be held to vote on the question of issuing $25,000 in bonds for installing a light and power plant and $10,000 bonds for the waterworks system.

SOUTH CENTRAL STATES.

Carrollton, Ky.—City has awarded a contract to Frazier & Morrell, Lexington, Ky., for the construction of the new municipal electric light and power plant, estimated to cost $32,184. J. E. Gullion is mayor.

Dawson Springs, Ky. — United States Government, Treasury Department, is arranging for the installation of new power plant and mechanical equipment in a total of 19 buildings at the local U. S. Public Health sanitarium, estimated to cost $381,530.

Mayking, Ky.—Pine Creek Coal Co. is planning for the erection of a new power plant on its Mayking properties.

Bonita, La.—Ways and means are under consideration by the city officials for securing a municipal light and water system. Address Dr. A. B. Gregory, mayor.

Monroe, La.—City has voted bonds for $350,000 for the construction of an electric light and power plant, with waterworks system in conjunction. Walter F. Kirkpatrick, Monroe, is consulting engineer. Arnold Bernstein is mayor.

Jonesboro, Ark.—Arkansas Brick & Lumber Co. is reported in the market for equipment for a brick plant and

planing mill. C. W. Culberhouse is president.

Little Rock, Ark.—Little Rock Railway & Electric Co. is planning for extensions in its power plant to increase its present capacity. Bonds for $375,000 have been provided for the work which will include the installation of new boilers and equipment.

Little Rock, Ark.—Arkansas Hydroelectric Development Co., Boyle building, will equip a plant with a first installation of 3000 hp. on Red river and ultimately increase the investment to about $5,500,000. E. T. Stanfield is general manager.

Enid, Okla.—Bids will be received Feb. 26 for constructing sewer disposal works and reservoir. Specifications include motor drum pumps. Address M. A. Garber, mayor.

Miami, Okla. — Northeast Oklahoma Railroad Co., formerly Northeast Oklahoma Traction Co., has bought the road formerly operated by the Oklahoma, Kansas City and Missouri railroad, from Miami to Century, Okla., 15 miles, via Commerce, Cardin and Picher, and is converting it to electromotive power for both passenger and freight service. W. J. Martin is chief engineer.

Tulsa, Okla. — Sands Spring Telephone exchange has been sold by Davis Bros. to James Thompson, Booneville, Mo. Mr. Thompson will rebuild the plant.

Albany, Texas — Chamber of Commerce is promoting the construction of an electric light and power plant here. If this is not done the American Public Service corporation of Dallas may build an extension of its high-power electric transmission line from Abilene to Albany, it is stated.

Brownwood, Texas — City council has appropriated $50,000 for the construction of a municipal electric light plant here.

Caldwell, Texas — The Caldwell Electric Power and Ice Co. will install a new 100-hp. engine and other machinery and equipment in its electric light and power plant here.

Clarendon, Tex. — Texas Gas & Power Co. is planning for extensions to its electric light plant for increased capacity.

Houston, Tex.—W. H. Irvin plans to spend $500,000 in additions to his ice and ice cream manufacturing plants. A cold storage plant will also be built.

Navasota, Tex.—Chamber of Commerce has perfected plans for the construction of a new power plant with initial capacity of about 250-hp. The station is estimated to cost $60,000, including equipment.

Tehuacana, Tex. — With the completion of an electric transmission line from Mexia to Coolidge by way of Tehuacana, the latter town will establish an electric lighting system.

WESTERN STATES.

Helena, Mont. — City council has under consideration the construction of a hydroelectric power plant to supply energy for city lighting and power.

Ryegate, Mont. — Montana Power Co., Butte, contemplates extension of its lines to this city for light and power.

Whitehall, Mont.—An election will be held to determine whether the village will own its own lighting plant and purchase power from Wagsted and Mattson, or give a franchise to the Wisconsin-Minnesota Light & Power Co.

Levenworth, Wash.—Tumwater Light & Power Co. will build a modern plant.

Port Angeles, Wash.—Chris Kuppler & Sons, Seattle and Port Angeles, have been awarded the contract for the erection of a paper mill at Port Angeles for the Washington Pulp & Paper Corporation, which will cost $200,000, exclusive of equipment.

Seattle, Wash.—Ne Page-McKenna Co., electrical engineer and contractor, plans for the construction of a 2-story factory, 145 by 122 ft., for use as a foundry, machine and general work shop.

Seattle, Wash.—An appraisal of the Seattle & Rainier Valley Co. lines and equipment is being made by the city of Seattle to determine the price which the city shall pay for the property should it be desired to take over. It is the only privately owned line in the city. The property was offered to Seattle recently for $1,656,000.

Seattle, Wash. — Construction on the city's Skagit river hydroelectric project will not be begun until after the completion of the 25-mile railroad between Rockport and the power and dam sites.

Vancouver, Wash. — Investigations and surveys have been made by the Northwestern Electric Co., Portland, Ore., on the north fork of the Lewis river in Washington, with the idea of building an electric power plant. The company has owned power sites on the river for several years, and while it is stated by G. C. Pierce, general manager, that work on such plant may be begun next autumn, no definite plans have been matured.

Yakima, Wash.—Electric Power & Appliance Co. has been incorporated here and will maintain a farm-lighting plant department and handle the numerous lines of electrical accessories and appliances manufactured by the Western Electric Co.

Lebanon, Ore. — Lebanon Electric Light & Power Co. is preparing to erect a new plant on Main street. Specifications include two new water wheels, electric generators and pumping equipment.

Salem, Ore.—Eugene & Coos Bay Land Co., of Cooston, Ore., has filed application with the state engineer to appropriate water from a lateral branch streams tributary to Willanche Creek for the Crawford Point Water, Light and Power Co., to furnish water for domestic use. The necessary construction work will cost $75,000.

CANADA.

Brantford, Ont. — Dominion Steel Products Co. will build a new foundry for the production of steel castings to cost approximately $150,000. It will adjoin the present plant and will be 100 by 160 ft., of brick and steel construction.

Galt, Ont. — Galt Brass Co. has completed plans for the erection of an addition to its plant.

Niagara Falls, Ont. — Work will start immediately on alterations to a building for a machine shop to cost $12,000 for G. D. Wilson and Harry Sham, 122 Buchanan street. New machinery will be installed.

Ottawa, Que. — Mortimer Co., 259 Sparks street, is in the market for one 15-hp. d-c motor, 500-volt compound wound, speed not more than 1200 r. p. m.

INCORPORATIONS.

New York, N. Y.—Blue Bird Lamp Co. Capital, $25,000. To manufacture electric lamps, etc. Incorporators: S. Mandel, D. Wolf, and R. H. Herschman, 45 East 17th street.

New York, N. Y.—M. McTigue Co. Capital, $100,000. To manufacture motors, engines, etc. Incorporators: P. A. Talbot, M. McTigue, and J. R. Taylor, 260 West 57th street.

Brooklyn, N. Y.—Pioneer Electric Service Corp. Capital, $20,000. To engage in general electrical contracting. Incorporators: H. London, 447 Saratoga avenue; I. Trussack, and M. Eisenberg.

Brooklyn, N. Y.—Blythbourne Electric Co. Capital, $5000. To manufacture electrical goods, etc. Incorporators: M. C. Groom, G. Clarke, and J. F. Tausch, 32 Broadway.

Buffalo, N. Y. — Sinclair Manufacturing Corp. Capital, $50,000. To manufacture motors, engines, parts, etc. Incorporators: L. A. Hallstead, L. L. Sinclair, and J. C. Kennefick.

Buffalo, N. Y.—Samuel Wright & Son. Capital, $75,000. To engage in a general electrical engineering capacity. Incorporators: S. and J. C. and K. S. Wright.

Waterbury, Conn. — Weston Battery Co. Capital, $5000. To manufacture batteries and kindred specialties. Incorporators: Samuel Tafel, 330 Willow street, Waterbury; Harry Weston, Jr., and F. S. Barnes, New Haven.

Trenton, N. J. — Reliable Battery Co. Capital, $50,000. To manufacture electric batteries, etc. Incorporators: Harry W. Case, Elmer E. Rue, and C. O. Ferguson.

New York, N. Y.—American Diesel Engine Co. Capital, $1,000,000. Incorporated under Delaware laws to manufacture Diesel engines. etc. Incorporators: Henry P. Molloy, F. X. Hennessey, and Wallace Ingraham, all of New York.

Newberry, S. C.—Newberry Electric Co. Capital, $5000. To manufacture electrical goods. Incorporators: J. C. Goggans, Jr., and W. S. Cameron.

Personals

H. E. Stocker Leaves General Electric to Join Roth Bros. —H. G. Wilson Takes Up New Work—Personnel Changes

R. N. BENJAMIN has been transferred from the department of engineering of the Georgia Railway & Power Co. to the development department.

CLARENCE B. STROHM, who has been district manager for the Western United Gas & Electric Co., Aurora, Ill., has been elected vice-president of that company, to succeed his brother, the late R. N. Strohm.

J. GRIER CAMPBELL, purchasing agent of the Blaw-Knox Co., Pittsburgh, Pa., has resigned to become assistant treasurer of the C. D. Pruden Co. WILLIAM S. BOYD, formerly assistant purchasing agent of the Crucible Steel Co., and purchasing agent of the Page Steel & Wire Co., succeeds Mr. Campbell in the Blaw-Knox organization.

JAMES E. HAMMER, Philadelphia, Pa., assistant general manager and purchasing agent of the H. C. Roberts Electrical Supply Co. of that city, was tendered a testimonial dinner by his associates, following the completion of 25 years' service with that organization. Mr. Hammer was presented with a gold watch by Frederick E. Stow, secretary and treasurer of the company, who presided.

C. M. JANSKY, JR., has been appointed an instructor in electrical engineering at the University of Minnesota, to specialize in radio and transients. Mr. Jansky is a graduate of the University of Wisconsin. He has had teaching experience in army training schools and in the University of Wisconsin, following several months of research work on military intelligence problems at the Western Electric Laboratories in New York City, which were continued at the University of Wisconsin. At the University of Minnesota his work will include courses with the signal corps unit of the Reserve Officers' Training Corps and other advanced students.

HOWARD G. WILSON, former assistant secretary of the Underwriters' Laboratories, Chicago, resigned that position Feb. 7 last to accept a position as vice-president of William F. Pelham & Co., Chicago. Since 1911 Mr. Wilson has been engaged in work in the fire insurance field, beginning as an inspector for the Chicago Board of Fire Underwriters. In 1914 he resigned to become fire protection engineer for Fred S. James & Co., taking charge of their risks located in the central western states. Much of his work during six years of service with the Underwriters' Laboratories has been that of editing publications, reports and standards, formulating office methods and systems and purchasing supplies. Mr. Wilson is succeeded by G. T. Bunker, who is a graduate in mechanical engineering of the University of Wisconsin, and who has been engaged for a number of years in industrial engineering work in and near Chicago.

H. E. STOCKER, who for a number of years was production manager of the Fort Wayne works of General Electric Co., has become general manager of Roth Brothers & Co., motor manufacturers, 1400 West Adams street, Chicago. For the 23 years preceding June, 1918, Mr. Stocker was connected with the General Electric Co. Starting with a grammar school education, he entered the Lynn (Mass.) plant of the company as an office boy and by his own unaided efforts rose to positions of increasing responsibility until in 1916 he became production manager of the

H. E. Stocker.

Fort Wayne works. In June, 1918, he became general manager of the International Clay Machinery Co., of Dayton, O., where he performed some exceptional things in connection with this company's production of war materials. In his new position, Mr. Stocker has entire charge of the company's affairs with duties usually incident to the position. Recently, Roth Brothers & Co. have developed their business into a wider field of motor application and the addition of Mr. Stocker's abilities to this long established organization will greatly supplement its strength. New facilities are being provided for the manufacture of a greater output.

W. E. HERRING, industrial agent of the Puget Sound Traction, Light & Power Co., has left Seattle for Boston, where he joins the engineering staff of the Stone & Webster Engineering corporation. Mr. Herring joined the Puget Sound company as traction agent in 1913 and has retained the position ever since. He was formerly chief engineer of the forestry service, with headquarters in Washington, D. C.

Obituary.

HAROLD MCGILL DAVIS, publicity manager for the Sprague Electric works of the General Electric Co., Bloomfield, N. J., died on Feb. 9 at his home, 329 73rd street, Brooklyn, N. Y., aged 59 years.

EDWIN T. HOLMES, president of the Holmes Electric Protective Co., New York City, died of pneumonia at his home in that city recently. Born in Boston in 1849 Mr. Holmes had been a prominent figure in the electrical industry for more than half a century. He was closely connected with Dr. Alexander Graham Bell in the development of the telephone, becoming associated with him in 1868 shortly after the formation of the Holmes Protective Co., of Boston. The first telephone central switchboard was built by Mr. Holmes and installed in the Boston office. The telephones of the system were connected with the burglar alarm wires.

HENRY SMITH CARHART, widely known as a scientist, specializing in electricity, died at his home, Pasadena, Cal., Feb. 13, aged 76 years. Professor Carhart was born at Coeyman, Albany county, N. Y., March 27, 1844. His people were farmers and his early education was obtained at country schools. When only 16 years old he taught a district school to gain funds with which to enter college. He was graduated from Wesleyan University in 1869 with the highest honors, being the valedictorian of his class. After graduation he taught two years at the Hudson River School at Claverack, N. Y., and then took one year of post-graduate work at Yale. In 1872 he went to Northwestern University, Chicago, as instructor in civil engineering and physics. The next year he was made professor of physics and remained in that position until 1886 when he took the same chair at the University of Michigan. In 1889 he introduced the electrical engineering course at Michigan and remained in charge of it for 20 years, when he retired from active teaching work, becoming professor emeritus of physics at the institution. Professor Carhart designed and built the physical laboratories at Northwestern and Michigan universites. He was a fellow of the American Association for the Advancement of Sciences, American Institute of Electrical Engineers, foreign member of the London Institution of Electrical Engineers and American Physical Society. He was a member of the International Jury of Awards at the Paris exposition and was president of the board of judges of the department of electricity at the World's fair in Chicago in 1893.

For the Readjustment Period—What?

Meeting The Issue— From Labor's Standpoint

Production is the battle song of the world today!

Produce. Produce. Produce.

Translated into action, this means work, more work, and most work.

Co-operation is needed to help speed production.

That's the kind of work that makes permanent success.

We all know thousands of manufacturing concerns employing now millions of skilled and unskilled labor who began business in a small way with 10, 25, 50 or 100 men in their plant.

The increase in number of men came as a result first of making a product worth while at a fair price to the consumer, then co-operation of employer and employés created consumer demand, and, behold, the 10, 25, 500, or 1,000 employés increased to 10,000 or 25,000.

Let us wake up all Americans.

Make Americanization mean production—more production—through hard work intelligently directed toward a definite goal—and that goal should be to lower the cost of living through greater production and the elimination of strikes and disturbances of all kinds.

The pungent and timely comments above are taken not from any financial journal or from any member of the "capitalistic" press, but from a workingman's paper known as "The Union Labor Advocate." If the workingmen of the country, or at least their leaders, have begun to swing around to the view which this editorial expresses, it is an encouraging indication that employers will eventually be met at least half way in their efforts to meet the present acute situation of production, high costs and inflation.

C. A. TUPPER - - - President
INTERNATIONAL TRADE PRESS, Inc., Chicago

Financial News

Chicago Telephone Shows Deficit.

Annual report of the Chicago Telephone Co. for the year ending Dec. 31, 1919, shows that the company had a deficit during the year, both under government operation and private control. For the year from July 31, 1918, to July 31, 1919, while the company was under government control there was a deficit of $1,875,669, while under private control from Aug. 1, 1919, to Dec. 31, 1919, there was a deficit of $167,820.80, which was charged against surplus account. The annual report of the company, issued Feb. 11, shows that the government took in $25,510,094 and spent $27,386,574. Included in expenses is $4,147,741 compensation to the company for use of its property. On Dec. 31 last the number of company stations was 675,836, an increase of 62,352 during the year.

Cities Service Earnings for November.

Cities Service Co. in November, 1919, continued to make satisfactory progress in earnings, gross income of the corporation for the month showing an increase of $114,404 over the preceding month, while the balance available for reserves, dividends on the common stock and surplus for November, 1919, was $123,635 larger than the corresponding balance for October, 1919. Earnings of Cities Service Co. for November, 1919, available for reserves, dividends on the common stock and surplus were $322,455 larger than the corresponding balance for August, 1919, this increase indicating the steady advance the company has been making in earnings since midsummer.

Reports from public utility subsidiaries of Cities Service Co. indicate steady progress being made in net earnings, taking the properties as a group, and while the coal strike and orders of the Fuel slight effect, yet this was but temporary Administration affecting consumption of current for light may have had some and continued progress in utility net earnings, especially those of the central station electric companies, may be expected.

Boston Elevated to Issue Bonds.

Trustees of the Boston Elevated Railway have petitioned the Massachusetts Department of Public Utilities for authority to issue $1,500,000 notes, or coupon bonds, payable in not exceeding 30 years, and bearing interest not exceeding 7%, for the purpose of refunding a similar amount of 6% bonds which mature on March 1, next.

Allis-Chalmers Co.

Report of the Allis-Chalmers Manufacturing Co., Inc., for the quarter ending Dec. 31, 1919, shows net profits after all expenses and reserve for Federal taxes of $760,434, equivalent after charging out preferred dividends at rate of 7% per annum to $1.85 a share ($100 par value) earned on the $25,770,750 common stock.

Income account for the period shows as follows:

Sales billed 1919.		Net profits 1919.	
October	$2,310,278	October	$290,322
November	1,923,018	November	236,308
December	2,096,176	December	233,804
Total sales	$6,329,472	Total profits	$760,434

Unfilled orders on hand, Dec. 31, 1919, amounted to, approximately, $16,000,000.

NORTHERN OHIO TRACTION & LIGHT CO.

Earnings of operating subsidiary of Northern Ohio Electric Corp. for 12 months ended Nov. 30, compare as follows:

	1919.	1918.
Gross earnings	$ 839,960	$ 574,179
Net after taxes	269,582	140,499
Surplus after charges	149,753	39,176
Bal. after prefer. div.	122,532	12,803

Buffalo General Electric.

Buffalo General Electric Co. has issued its annual report for the year ending Dec. 31, 1919, showing surplus after charges of $726,239, equivalent to $9.50 a share ($100 par value) earned on the outstanding $7,642,300 capital stock, as compared with $589,421, or $10.62 a share earned on the $5,545,700 capital stock in the preceding year.

Income accounting for the year ending Dec. 31, 1919, compares as follows:

	1919.	1918.
Total revenues	$5,336,008	$5,373,702
Net after expenses and taxes	1,425,901	1,294;881
Gross income	1,513,368	1,415,554
Balance after charges	726,239	589,421
Dividends	497,059	429,791
Surplus	229,180	159,630
	1917.	1916.
Total revenues	$4,209,719	$3,356,953
Net after expenses and taxes	1,365,049	1,102,018
Gross income	1,479,757	1,226,007
Balance after charges	798,518	686,723
Dividends	374,335	299,151
Surplus	424,183	387,572

SOUTHERN CALIFORNIA EDISON CO.

Earnings for November and 12 months ended Nov. 30, compare as follows:

	1919.	1918.
November gross	$ 920,789	$ 668,681
Net after taxes	455,943	433,850
Surplus after charges	206,063	184,362
12 months' gross	10,481,694	8,608,979
Net after taxes	6,135,996	5,308,559
Surplus after charges	3,032,566	2,386,215

Gross earnings include other income.

WESTERN STATES GAS & ELECTRIC.

Gross and net earnings of Western Gas & Electric Company (of Delaware) and subsidiaries, for the years ended Dec. 31, 1919 and 1918, are reported as follows:

	1919.	1918.
Gross earnings	$1,901,303	$1,628,996
Net earnings	782,900	643,594

Duquesne Light Co.

Earnings of the Duquesne Light Co. and subsidiary electric light and power companies for December and the 12 months ended Dec. 31, 1919, compare with 1918 as follows:

	1919.	1918.
December gross	$1,199,162	$1,149,759
Net earnings	386,614	448,720
12 months' gross	11,917,566	11,213,621
Net earnings	4,139,671	3,769,209

Net earnings do not include income from investments and are before provisions for interest on debt and other income deductions.

VIRGINIA RAILWAY & POWER.

Earnings for December and six months ended Dec. 31, compare as follows:

	1919.	1918.
December gross	$ 862,549	$ 722,955
Net earnings	348,815	250,646
Surplus after charges and taxes	159,107	90,824
6 months' gross	4,792,051	4,036,765
Net earnings	1,873,205	1,261,768
Surplus after charges and taxes	832,263	302,437
Surplus after charges and taxes	*832,263	*302,437

*Before depreciation, which is written off at the end of each fiscal year.

Dividends.

The Philadelphia Electric Co. has declared the usual quarterly dividend of 1¾%, payable March 15. Books were closed on Feb. 19.

West Penn Power Co. has declared a quarterly dividend of 1¾% on preferred stock, payable Feb. 1 to stock of record Jan. 21.

West Penn Traction & Water Power Co. has declared a quarterly dividend of 1½% on preferred stock, payable Feb. 16 to stock of record Jan. 19.

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

	Div. rate. Per cent.	Bid Feb. 10.	Bid Feb. 17.
Public Utilities.			
Adirondack Electric Power of Glens Falls, common	6	14	16
Adirondack Electric Power of Glens Falls, preferred	6	78	78
American Gas & Electric of New York, common	10+extra	122	121
American Gas & Electric of New York, preferred	6	39	39
American Light & Traction of New York, common	..	180	180
American Light & Traction of New York, preferred	6	88	88
American Power & Light of New York, common	4	60	57
American Power & Light of New York, preferred	6	70	70
American Public Utilities of Grand Rapids, common	..	7	7
American Public Utilities of Grand Rapids, preferred	7	18	18
American Telephone & Telegraph of New York	..	97¾	97½
American Water Works & Elec. of New York, common	..	2	2
American Water Works & Elec. of New York, particip	7	5	4
American Water Works & Elec. of New York, first preferred	..	47	47
Appalachian Power, common	..	2	2½
Appalachian Power, preferred	7	20	20
Cities Service of New York, common	+extra	365	365
Cities Service of New York, preferred	6	68	69
Commonwealth Edison of Chicago	8	106½	106½
Comm. Power, Railway & Light of Jackson, common	..	18	17
Comm. Power, Railway & Light of Jackson, preferred	6	39	37½
Federal Light & Traction of New York, common	..	6	6
Federal Light & Traction of New York, preferred	..	43	43
Middle West Utilities of Chicago, common	..	20	18
Middle West Utilities of Chicago, preferred	..	40	36
Northern States Power of Chicago, common	..	59	56
Northern States Power of Chicago, preferred	ex.div.7	87	86
Pacific Gas & Electric of San Francisco, common	..	51½	51
Public Service of Northern Illinois, Chicago, common	7	79	77
Public Service of Northern Illinois, Chicago, preferred	6	88	85
Republic Railway & Light of Youngstown, common	4	17	14
Republic Railway & Light of Youngstown, preferred	6	45	46
Standard Gas & Electric of Chicago, common	..	25	20
Standard Gas & Electric of Chicago, preferred	6	40	38½
Tennessee Railway, Light & Power of Chattanooga, common	..	1	1
Tennessee Railway, Light & Power of Chattanooga, preferred	6	7	7
United Light & Railways of Grand Rapids, common	4	24	24
United Light & Railways of Grand Rapids, preferred	6	60	59
Western Power of San Francisco, common	..	21	20
Western Union Telegraph of New York	extra	85	84
Industries.			
Electric Storage of Philadelphia, common	4	125	112
General Electric of Schenectady	8	156	157
Westinghouse Electric & Mfg. of Pittsburgh, common	7	50¾	50¼